08-059-00701

BEFORE THE OIL AND GAS CONSERVATION COMMISSION
OF THE STATE OF COLORADO

08-18-2003

REQUEST FOR ORDER AUTHORIZING THE CLOSURE OF THE LEYDEN UNDERGROUND NATURAL GAS STORAGE FACILITY IN THE CAVERNS ABANDONED BY LEYDEN COAL MINE	CAUSE NO. 146 DOCKET NO. 0304-GA-02

PURSUANT TO NOTICE to all parties in interest, the above-entitled matter came duly on for hearing at the Colorado School of Mines, Green Center, Petroleum Hall, Golden, Colorado, 80401, commencing at 11:00 a.m. on Monday, August 18, 2003.

COMMISSIONERS:
CHAIRMAN PETER J. MUELLER
COMMISSIONER TOM ANN L. CASEY
COMMISSIONER BRIAN J. CREE
COMMISSIONER LYNN J. SHOOK
COMMISSIONER MICHAEL W. KLISH
COMMISSIONER J. THOMAS REAGAN

Richard Griebling, Director
Brian Macke, Deputy Director
Patricia Beaver, Manager of Commissioner Affairs

APPEARANCES

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(All exhibits were admitted.)

CHAIRMAN MUELLER: Can we get started, please. Please come to order. Okay. We're continuing on with our proceeding today, Cause No. 146, Docket No. 0304-GA-02, the Leyden Gas Storage Field in Jefferson County. The applicant is Public Service, with William Keefe and James Albright. Protestants was El Dorado Estates Homeowners Association, Mobelisk LLC and Northwest Industrial Subdivision and Union Pacific Railroad. And in that matter, I have a couple of comments I would like to share with the audience before we get started with the presentations. And I think it's important to keep in mind what we're here for.

The purpose of this hearing is to develop the best means to close Leyden as a gas storage facility. Another way of saying is that we're not here not to close it. We're here to figure out the best means and methods to close Leyden, considering public health, safety and welfare and the environment.

We have heard a number of concerns in previous hearings and I'll list a few: Gas migration, gas left underground, subsidence, potential for water in basements, loss of rights to drill water wells in the area, and those are concerns that, hopefully, we'll hear the testimony that answers those concerns and potentially others.

Two things are going to happen. The facility will be shut down as a gas storage reservoir, and the other thing is that the cavern will fill with water, whether naturally or accelerated through the City of Arvada's use. There's been quite a bit of work done to date. There have been, I believe, seven prehearing conferences, and discovery that went along with that part of the process, expert reports, et cetera. Let me go through the process of the hearing, so everybody knows what's coming down the road.

Today we're going to start with Public Service Company presenting their plan. I expect that will take us probably through the end of today. We'll start with Public Service's plans for -- start with some of their company personnel, and then their expert witnesses. Also, Mark Floyd with the City of Arvada -- Mark, would you just identify yourself.

MR. FLOYD: (Raising hand.)

CHAIRMAN MUELLER: He's present to answer questions regarding the City's plans to use the cavern for water storage. Tomorrow is, as I mentioned earlier, we're going to move across the hall over to Metals Hall. And some of the folks from the Department of Natural Resources will also present some testimony, including the Oil and Gas Commission staff, Department of Minerals and Geology staff and Water Resources. After that -- and I expect that could start somewhere around 9 o'clock, or earlier. We will start the hearing tomorrow morning at 8. I expect that we'll probably be ready for 510 statements at about 9 o'clock in the morning, and, Carol, you had some comments you want to make about 510 statements.

ASS'T ATTORNEY GENERAL HARMON: Talking about 510 statements.

CHAIRMAN MUELLER: Let me --

ASS'T ATTORNEY GENERAL HARMON: There's been some confusion about our Rule 510, and what can be submitted by way of comments and documents through 510 statements. And I would like to provide some guidance, right now, before we get to that tomorrow.

Under our Rule 510 -- ours meaning the Colorado Oil and Gas Conservation Commission's Rule 510 -- any person can make an oral statement or submit a written statement at the hearing that relates to the proceeding that is before the Commission. In this particular proceeding, Commissioner Mueller, as the hearing officer, has limited 510 statements to up to 30 minutes per person. Public Service Company has the right to cross examine anyone making a sworn statement under Rule 510. And under our rule, all of the statements will be sworn in, and Public Service will have an opportunity to cross examine.

There were some particular questions on documents and the ability to introduce documents and other information during a 510 statement during one of our prehearing conferences; and that a person can request -- attempt to introduce that information, or those documents, describe it to the Commission. If Public Service -- I should say Public Service has the right to object to the introduction of some of that information. And then it's up to the Commission to decide whether or not to allow that information into the record.

If they sustain the objection, then the information will not be part of the record, and the Commission cannot base any of its findings or decisions on that information. If they decide to overrule the objection, the information comes in. It's subject to the objection, for the record, by Public Service. Public Service can cross examine on that information, and they can also provide rebuttal testimony to that information.

Those are my comments on 510 statements right now. Does anyone have any questions about those at this time?

MR. EATHERTON: You had stated that there would be cross examination after the 510 statements. Does the cross examination pertain only to the information that was given during the 510 statement or does it pertain to information that has been a part of the case?

ASS'T ATTORNEY GENERAL HARMON: Cross examination typically is restricted to testimony and information that is provided at that time --

MR. EATHERTON: Thank you.

ASS'T ATTORNEY GENERAL HARMON: -- during the 510 statement.

CHAIRMAN MUELLER: Thank you. A few more things on 510s. We scheduled 510 statements to go after the Public Service Company witnesses and the DNR witnesses in order that the direct testimony and informations can be brought forward in an effort to answer some of those concerns that are out there, and that the public can hear those plans and then decide if they want to make comments.

Also, as far as persons making 510 statements, they will be asked to sign up before they make their comments, and also to briefly describe what they plan to discuss or talk about.

COMMISSIONER SHOOK: Mr. Chairman.
CHAIRMAN MUELLER: Yes, sir.
MR. EATHERTON: I am sorry. How far in advance do they need to sign up for 510 statements?
CHAIRMAN MUELLER: Well, it would be good, if we could get started by 9, if they can be at least -- I don't know -- a sufficient length of time so we're aware who is coming up and we have a chance to just take a look at the list. That's all.
MS. BEAVER: The sheets are out there, by the way.
CHAIRMAN MUELLER: And the sheets are already out there for sign-up. And depending on the number and length of the statements, we will adjourn tomorrow by 6 p.m. and then Wednesday, we'll start up again at 8 a.m., and again with response or rebuttal to any 510 statements. As far as the closing statements, they will follow and then deliberation we plan to start no later than noon on Wednesday.
As far as the status of the application, the only party to the hearing at this time is Public Service Company. The protestants have voluntarily withdrawn from the proceedings, and that leaves Public Service's plans effectively uncontested via official protestants. Because there are no protestants, there

will be no cross examination of Public Service Company's witnesses, other than questions from the Commissioners. So, I encourage questions.

The COGCC will review the plan for its merits. The COGCC staff has reviewed the plan as well. Other DNR agencies have reviewed the expert reports from Public Service and the Commissioners have also been provided with this information prior to the hearing.

I also just want to note that I applaud UPRC's willingness to move this matter forward by proposing a very reasonable and forward-looking settlement. I would like to also make a note as for the audience. I think the Commissioners that we have today are kind of a unique collection of experience, and variable backgrounds, and will serve this matter well. I'll just introduce them. Tom Ann Casey is a geologist by training. At the other end, Tom Reagan is a petroleum engineer and also has a banking background. Michael Klish is an environmental scientist. Lynn Shook is agriculture and with an agricultural background. Michael Cree has a financial background, but also has petroleum experience as well. And I am also a petroleum engineer.

There will be a couple of other folks

from the state that are involved in this: Trisha Beaver is our hearings manager; Carol Harmon, our Assistant Attorney General; Morris Bell, also with the Oil and Gas Commission staff, will present testimony tomorrow.

MR. BELL: Yes.

CHAIRMAN MUELLER: Then also we have Brian Macke and Director Griebling. So, with that, are there any questions? I would like to begin.

MR. KEEFE: Thank you, Mr. Chairman. Couple of preliminary matters, if we could. I want to confirm, first of all, that the application and especially the plan that was attached to the application are already part of the record for purposes of this proceeding. Am I correct in assuming that?

CHAIRMAN MUELLER: I'm sorry. Please repeat that.

MR. KEEFE: That the application and attached plan are already part of the record. They normally are, and I just want it on record, so we don't have to introduce things separately.

CHAIRMAN MUELLER: Okay. That's my understanding that they are.

MR. KEEFE: The second thing is I would also -- also understand that the records of the prehearing conferences are part of the record in this matter.

CHAIRMAN MUELLER: Yes.

MR. KEEFE: And, finally, this is just a question that I want to make sure that I've got covered before we move on, and that is you were the appointed hearing officer. I'm assuming that all of the decisions that you made are considered final decisions by the Commission; is that correct?

ASS'T ATTORNEY GENERAL HARMON: As part of the preliminary matters, the Commission will be approving or deciding whether or not to approve his decisions -- Commissioner Mueller's decisions -- as hearing officer in the prehearing conferences. I think Trisha has -- have we prepared something for them to --

MS. BEAVER: Well, the thing that was prepared was a document that was sent out in your packets that gave a background of the prehearing conference summaries, and the decisions that Chair Mueller made as hearing officer. So, I think it's just --

ASS'T ATTORNEY GENERAL HARMON: As a procedural matter, the Commission needs to move to approve those decisions that Commissioner Mueller made, vote on them and then those decisions become final for purposes of --

MR. KEEFE: Is that proper, to have that done at this point?

ASS'T ATTORNEY GENERAL HARMON: Yes. Yes, before we start on the hearing.

CHAIRMAN MUELLER: So we need a motion.

ASS'T ATTORNEY GENERAL HARMON: Or if they had questions. . .

CHAIRMAN MUELLER: Okay. Have the commissioners had a chance to review those?

COMMISSIONER REAGAN: Yes.

COMMISSIONER CASEY: Yes.

CHAIRMAN MUELLER: Any questions or concerns with the decisions that were made?

COMMISSIONER REAGAN: No.

CHAIRMAN MUELLER: Okay. I would like to make a motion, then, to approve those.

COMMISSIONER REAGAN: I make a motion that the decisions made by Commissioner Mueller, and in his capacity as hearing officer, be approved by the full Commission at this time.

COMMISSIONER CREE: Second.

CHAIRMAN MUELLER: So moved.

(Whereupon the vote was called.)

CHAIRMAN MUELLER: So the motion carries.

MR. KEEFE: Thank you, Mr. Chairman. The only other thing I have was with respect to Assistant Attorney General Harmon's description of the 510 statements. I'm assuming that we would have the ability, in any cross examination, to establish the credibility of the witnesses.

ASS'T ATTORNEY GENERAL HARMON: That's right.

MR. KEEFE: Is that correct?

ASS'T ATTORNEY GENERAL HARMON: Yes. That's a traditional part of cross examination.

MR. KEEFE: Okay. I just wanted to ensure -- that wasn't totally clear. I assumed that you meant that. I wanted to get that clarified.

We're ready to begin with our opening statement, Mr. Chairman, if you would like us to do that.

CHAIRMAN MUELLER: Please.

MR. KEEFE: All right. Since the hearing in April, much has happened regarding this application of Public Service Company, as you probably know, from just having read the prehearing conference reports. Before we summarize those events, it is appropriate to review what transpired at the April meeting itself. At that hearing, Mr. Bill Uding, the gas storage project director for Public Service Company, reviewed the history of the Leyden Facilities and outlined the plan proposed to close the facility. This was followed by a public comment period, where various concerns regarding closure of the facility were expressed by various members of the public.

It is the intent of Public Service Company to address all of those concerns today as part of its presentation. The last part of your April hearing was devoted to the means by which various motions of the parties should be addressed, with the result that you appointed a hearing officer, Mr. Peter Mueller, to hear these motions and to otherwise conduct prehearing conferences as a prelude to today's hearing.

As you are probably aware, since the April hearing, there have been five prehearing conferences. At the first two of these, the means by which discovery would be undertaken was addressed by the hearing officer, with the result that Public Service Company made available to the protestants documents totalling more than 70,000 pages for inspection and copying by the protestants. Public Service Company's document room was open to the protestants for inspection and copying for a total of 15 business days.

Immediately following the close of the document room, three of the protestants, these being El Dorado Estates Homeowners Association, Mobelisk LLC and Northwest Industrial Subdivision withdrew from the evidentiary phase of this proceeding. Pursuant to motion made by Public Service Company at a subsequent prehearing conference, their protest was dismissed with prejudice. It is significant to note that the withdrawal of these protestants took place just prior to the dates set for deposition of their witnesses by Public Service Company. The remaining protestant in this proceeding, Union Pacific Railroad, now has also withdrawn from this proceeding.

So, today there are no protests remaining to Public Service Company's application. However, I should make it clear that withdrawal of all of the protestants from this proceeding will not in any way diminish the resolve of Public Service to address any and all issues concerning protection of public health, safety and welfare and protection of the environment relative to closure of the Leyden Gas Storage Facility.

Prior to beginning our evidence today, it's appropriate to review why we are here. We are here because of the promulgation of a statute by the Colorado legislature which vested with the Colorado Oil and Gas Conservation Commission the exclusive authority to regulate the public health, safety and welfare aspects, including protection of the environment, of the termination of operations and permanent closure of an underground natural gas storage facility, in this case, the Leyden Facility. Under the statute, the facility cannot be decommissioned unless Public Service has obtained a Certificate of Closure from the Colorado Oil and Gas Conservation Commission, and in order for the Commission to order such certificate, it must be shown that the closure plan protects public health, safety and welfare and protects the environment. Under the statute, the Commission may attach conditions to the Certificate of Closure if it determines that the conditions are technically feasible and necessary to ensure compliance with the statutory requirements, while taking into consideration cost effectiveness.

The statute suggests several conditions: First, a requirement for reasonable recovery of residual natural gas. Second, if the proposed closure includes the abandonment of the wells and reclamation of well sites associated with the storage cavern, a requirement that well abandonment and reclamation occur in a manner consistent with applicable Commission rules. Third, a requirement for reasonable post-closure monitoring and site security to close the facility. And fourth, if post-closure monitoring indicates that the closure does not protect public health, safety and welfare, a requirement to perform post-closure corrective actions. Under the statute, Public Service Company also is required to provide reasonable assurance that it is financially capable of fulfilling any obligations imposed under the closure statute, including any post-closure action.

Today, Public Service Company plans to call seven witnesses, six of which have been qualified as expert witnesses. Five of these expert witnesses have prepared reports, copies of which have been previously furnished to each of you. Our first witness will be Mr. Bill Uding, Public Service Company's gas storage project director, who will testify concerning the history of the Leyden Facility, and, more particularly, the plan for closure submitted by Public Service Company under the application. Next will be Benjamin Fowke, vice president and treasurer of Public Service Company, who will testify concerning Public Service Company's assurance that it is financially capable of fulfilling any obligation imposed under the statute.

Mr. Fowke will be followed by five

independent expert witnesses, each of whom was retained by my law firm, to evaluate the closure plan and address whether it satisfactorily protects public health, safety and welfare, and protects the environment. The first of these witnesses will be Dr. Robert Weimer, a distinguished geologist who will address the geologic issues that have arisen in this proceeding, including gas migration and seals. He will be followed by Mr. Dave Cox, an expert in petroleum engineering, who will address the various engineering issues, including potential for gas leakage out of the facility, the methods proposed to abandon wells and amount of gas which would remain in the facility at closing.

Next will be Mr. Greg Sherman, a geologist with an expertise in the evaluation of the subsidence risks associated with underground mines. He will be followed by Mr. Tom Hesemann, who is an expert in hydrogeology and will address various issues, including the potential for storage gas to be present in groundwater in the vicinity of the Leyden Facility. Our last witness will be Mr. David Folkes, an expert in the field of the investigation and remediation of contamination by gases, such as methane in soil, who will testify concerning the potential for storage gas being present within soils in the area of the Leyden Facility.

Although we do not plan to call any witnesses from the City of Arvada, Mr. Mark Floyd, who introduced himself earlier and is an engineer with the city, familiar with both the closure plan and the City of Arvada's intended future use of the cavern for water storage, is present so that he can answer any questions that the Commission may have concerning the City of Arvada's use of the facility as a water storage facility.

Now, if you would indulge me just for a moment before we go to the testimony portion of the hearing, it is important that I mention some of the things this hearing is not about. In your public hearing last April, you heard about civil action under which Public Service Company was held liable for damages due to diminution in value of the plaintiff's lands due to storage gas migrating under those lands. While Public Service Company respects that verdict, it believes that the verdict was incorrect. Your own director, Mr. Rich Griebling, has stated, on the record, that, in his opinion, no storage gas is present under the Northwest Industrial Subdivision II land located to the north of the facility.

Further, and most importantly, this civil action was not an action for damages. This was an action for damages suffered due to diminution in value. This proceeding today is not about diminution in value. Diminution in value is an issue to be decided by the courts. This proceeding is about protection of public health, safety and welfare and protection of the environment, which were not issues in the Northwest Industrial Subdivision case. And an even more important distinction is that this civil case that I am referring to, and three others which were subsequently dismissed, related to ongoing operations of the facility and had nothing whatsoever to do with closure. The hearing today is solely about closure and the proper plan for closure.

Mr. Chairman, I have seven witnesses to swear, and you may also want to swear the witness from the City of Arvada as well.

CHAIRMAN MUELLER: Okay. Thank you very much.

(Discussion off the record between Chairman Mueller and Assistant Attorney General Harmon.)

CHAIRMAN MUELLER: Okay. All right. If the seven witnesses, and Mr. Floyd, if you would raise your right hand.

(Whereupon the Public Service Company witnesses were sworn.)

CHAIRMAN MUELLER: Thank you very much.

MR. ALBRIGHT: Morning, Mr. Chairman, Commissioners. My name is James Albright. I am an Assistant General Counsel to Xcel Energy, representing Public Service Company of Colorado. The company's first witness today will be William Uding. I wish to call him to the stand at this time.

While he is coming to the stand, I would note that we have passed out exhibit books to all the Commissioners, as well as staff and the court reporter. Mr. Uding will be referring to his exhibits that are within that book.

MR. KEEFE: It's acceptable procedure just to move those exhibits, after his testimony is concluded. I would just follow that procedure.

CHAIRMAN MUELLER: That's fine.

EXAMINATION

BY MR. ALBRIGHT:

Q Mr. Uding, will you state your name and business address for the record.

A My name is Bill Uding. My business address is 550 15th Street, Suite 700, Denver, Colorado, 80202.

Q Have you been sworn in for purposes of your testimony?

A Yes.

Q By whom are you employed and in what capacity?

A I am employed by Public Service Company of Colorado, and as a gas storage project director.

Q And are you the same William Uding that testified at the April 16th, 2003 hearing before this Commission?

A Yes.

Q Mr. Uding, did you prepare or cause to be prepared, under your supervision, any exhibits for purposes of your testimony today?

A Yes. I have Exhibits A-1, A-2 and A-3.

Q Mr. Uding, I would refer you to the resume section of the exhibit book.

A That's my -- is there a way to turn this down?

MS. BEAVER: No. On and off. That's it.

THE WITNESS: Try that. Is it still on?

BY MR. ALBRIGHT:

Q Uh-hum. Mr. Uding, is your resume contained within that section of the exhibit book?

A Yes. It's the first one in the book.

Q For the benefit of those folks who may not have seen your resume, I would ask you to highlight a few of your qualifications as a gas storage engineer.

A I have a Bachelor of Science degree in civil engineering from the University of Missouri in 1977. Since that time, I've been employed --

CHAIRMAN MUELLER: Excuse me, Mr. Albright. Not all of the books have the resume.

MR. KEEFE: They should be the last portion.

CHAIRMAN MUELLER: I am sorry.

MR. KEEFE: The very last portion.

CHAIRMAN MUELLER: Sorry.

MR. ALBRIGHT: They are all together at the end.

CHAIRMAN MUELLER: Thank you.

THE WITNESS: Since that time, I've been employed continuously by Public Service Company of Colorado, or its subsidiaries, initially, as a gas distribution engineer. Shortly thereafter, I became responsible for the Leyden Gas Storage Facility in an engineering capacity, and, throughout the years, have retained responsibility for the engineer operation of Leyden Facility, as well as other gas storage facilities for Public Service Company.

BY MR. ALBRIGHT:

Q How many other gas storage facilities does Public Service Company operate, Mr. Uding?

A We own and operate three other gas storage facilities. There's the Round Up Storage Facility in Morgan County, Colorado, and the Asbury and Fruita Storage Facility in Mesa County, Colorado.

Q And how many years have your responsibilities included those facilities as well as Leyden Facility?

A Approximately 23 years.

Q Mr. Uding, what are your specific responsibilities with respect to the Leyden Facility?

A My responsibilities are to do all of the operations' engineering, the planning, budgeting and execution of construction projects, including wells at the storage facility, and do the reservoir engineering for the storage facility.

Q So, just about every decision that's made with respect to the operations of the facility goes through you, Mr. Uding?

A Pretty much does. I do not direct the staff or the on-site personnel, but all of the major operational issues, construction issues and engineering issues, flow through my office.

Q Mr. Uding, do you have any licenses or certifications?

A Yes. I am a licensed professional engineer in the State of Colorado.

MR. ALBRIGHT: Mr. Chairman, I would --

CHAIRMAN MUELLER: Pull that microphone just a little bit closer, please. Thank you.

MR. ALBRIGHT: Seems to be intermittent. Mr. Chairman, I would ask that the chair of the Commission accept Mr. Uding as an expert witness in the field of gas storage engineering.

COMMISSIONER REAGAN: Yes.

CHAIRMAN MUELLER: There are no objections. We accept him as an expert.

MR. ALBRIGHT: Thank you, Mr. Chairman.

BY MR. ALBRIGHT:

Q Mr. Uding, what is the purpose of your testimony today?

A The purpose of my testimony is to outline the storage -- or the closure plan for the Leyden Storage Facility and as well as to introduce three minor additions to the plan. And also to specifically address the issue of lost and unaccounted for gas reported at the Leyden Facility.

Q Mr. Uding, can you please give a brief description of Public Service Company's closure plan?

A Yes. We developed a plan that was submitted in the -- or was originally presented at the April hearing that we believe will permanently close the Leyden Facility and address the protection of the public health, safety and welfare and protection of the environment.

The major steps that are involved in the closure plan are the flooding of the cavern and displacement of the gas by water; the abandonment of the injection -- gas injection/withdrawal/observation wells and shaft sealing systems; the conversion of certain of these wells to water storage operations; the abandonment of the underground piping systems; the abandonment and removal of the surface facilities; the restoration of the surface sites where abandonments have been taken place.

There will be a period of monitoring that will be done with various wells and soil gas techniques over the facility. And then, finally, the ending of the post-closure monitoring and abandonment of the monitoring systems.

Q Mr. Uding, by way of background, would you please review a layout of the Leyden Facility, what it consists of and how it's operated over the last 43 years?

A Okay. I'm going to -- my first exhibit --

Q Is this Exhibit A-1?

A Which is Exhibit A-1, should be the first exhibit in the exhibit book. This has probably become a familiar figure for those of us who have seen this presentation before. The green-shaded area is the property that is the Leyden Storage Facility. That is the leased property or owned property by Public Service Company. For purposes of orientation, along the northern border of the facility is State Highway 72, to the west, is State Highway 93, and, essentially, through the middle of the facility is Leyden Road, which is an extension of 82nd Avenue.

Additionally, Public Service operates the compressor station offices referred to as "the plant." That is about a quarter mile to the east of the facility. The red, blue and green dots that are shown above the facility are the wells that have been operated for gas injection and withdrawal. These wells predominantly lead down to the storage cavern.

Just inside the edge of the green line is a jagged black line, which represents the extent of mining from the two caverns. The coal was mined from the Lower Laramie Formation at an approximate depth of 700 to 1000 feet from the two overlying coal seams that are both approximately 8 -- 7 to 8 feet thick. And I believe the original April transcript had a reported figure of 70 to 80 feet. I would like to make a correction. That is actually 7 to 8 feet.

The coal mining was conducted from 1903 to 1950. The mine was abandoned at that time. Public Service came to the area in 1958 to begin investigations for potential gas storage here. We found the facility nearly completely full of water. After a brief evaluation period, we went into full operation in 1961. Since that time, we have stored up to 3 billion cubic feet of gas as total storage volume. We've had the ability to inject up to 100 million -- 120 million cubic feet a day, and to withdraw up to 240 million cubic feet a day for delivery back into the system.

The geology of the area -- and, again, we have an expert that will detail this in very fine detail. The coal is found in the base of the Lower Laramie, again about 750 or 700 to 1100 feet deep. The Lower Laramie is a predominantly coal shale and some sandstone layer.

Then, above the Lower Laramie is the Upper Laramie, which, in many cases, comes nearly to the surface, comprised predominantly of shales, claystones and silt material.

Q Mr. Uding, has the Leyden Storage Facility operated safely during its 43 years of operation?

A Yes, it has. We have had, over our 43 years of operating history, we have had a handful of incidents that involve the discovery of gas outside of the storage area, but all of these incidents contain several things in common with one another. They were all related to manmade penetrations of the formations, either the shafts, wellbores from the mining era, or wellbores that Public Service Company had installed. And, further, all of these problems were found by Public Service Company while they were looking for such things, and all of them were promptly taken care of.

Q And when you refer to, "migration," there you are referring to gas actually migrating from the cavern to the surface?

A Yes.

Q Mr. Uding, were you instrumental in developing and drafting the closure plan that was filed with Public Service and the Commission, along with this application, on March 3, 2003?

A Yes, I was.

Q Mr. Uding, do you have the closure plan that Public Service filed?

A Yes, I do.

Q Is this the closure plan that Public Service requests the Commission approve with respect to the closure of Leyden?

A Yes, it is.

Q Would you please explain to the Commission what the closure plan includes and the steps that the company plans to take to close this facility?

A Yes. First, I would like to say that the plan that we're talking about is the same plan that was submitted to the Commission for its consideration in April. Since we -- since that time, we have had the benefit of several subject matter experts that have reviewed the plan and we have come up with three additions to that plan. And I'll briefly outline those now, and we'll go through them in more detail at a later time.

The -- one of the recommendations from one of our experts was to do an expanded soil gas survey. We currently do a soil gas survey over the facility. It's been a part of our ongoing monitoring effort, a part that will continue up through post-closure. A recommendation was made that we expand the soil gas testing over a broader area of the mined area itself. And, so, we will be adopting that and putting that in place as soon as the arrangement can be made to install that work. Another --

CHAIRMAN MUELLER: Excuse me. Can you describe, using the map, that better, the geographic extent of that survey.

THE WITNESS: Yes. The existing soil gas survey work is predominantly along the southeast perimeter of the field. The recommendation was to expand that over the mined cavern, partially to review potential boreholes that were installed during the mine era time. We have a map that shows some of the boreholes that we have not found by looking directly for those boreholes, but we are going to investigate those by soil gas survey in the areas that they are reported on maps.

Additionally, another expert has asked us to include one additional observation well in our post-closure monitoring period -- and at a later time, I'll describe it in more detail, the post-closure monitoring effort. But that effort was initially -- on this map, we have green circles around two wells that were a part of our post-closure monitoring. His recommendation is to include a third well, which is Well 34. And, again, we will adopt that recommendation.

The final recommendation has to do with additional water well drilling or future water well drilling in the area. And we'll be asking that this Commission recommend to the State Engineer's Office that they condition future well drilling -- water well drilling permits, within one-half mile of the facility, to require blowout prevention equipment during drilling.

Q Mr. Uding, please turn to Section 3 of the plan, if you would. Just basically describe the closure plan and how it's laid out and what's provided for.

A Okay. If anyone has the closure plan, you could follow along with this. Otherwise I'll just give a brief description of some of the activities that are -- that will take place as a part of closure. And this begins on page 6, in Section 3.

Flooding of the gas caverns. As a part of closure, to most effectively remove the gas from the gas storage cavern, we will be injecting water into both caverns, initially in Well 12 and Well 7, with potable water from the -- from the City of Arvada providing the water. And filling the cavern from the -- the cavern, again, tilts to the southeast, so this is, structurally, the lower end of the facility. We will be adding water to the lower end of the facility and using the structurally high wells to produce the gas into the gathering system and back to the plant. We'll continue injecting water until water has completely flooded the caverns and stands above the casing shoe of the, structurally, the highest well in both caverns. So, that's a rough outline of the flooding process.

The next section of the plan talks about conversion of certain gas wells to water storage operations. All of the wells will receive a similar treatment, up to a point. We got different groups of wells out here. We have got wells that will be plugged and abandoned, and, on this exhibit, the wells that are circled in red are the wells that are contemplated to be plugged and abandoned. The wells that are circled in blue are wells that are to be converted to water storage operations, but the initial part of the abandonment process applies to both of those groups of wells.

Initially, when the water flooding has

filled the cavern to the point that the water stands above the casing shoe of each of these wells, a plug, either temporary or permanent plug, depending on the well, will be set in the wellbore. The well will then be -- the wellbore above the plug will be filled with water. Each well will be cement bond logged. Each well will be -- will run a gas detection log, such as the thermal neutron log, in each of these wells. If any well has insufficient cement, that will be remedied. If any well has an indication of gas behind casing, that will be investigated, most probably by perforation and attempted production. Beyond that, the well will then be, if they are necessary, will be squeezed, and the wellbores will be filled with cement from the plug all of the way to the surface, and that being the wells that are to be abandoned.

The wells that are going to be turned over to water storage operations will not be filled with cement. The plug will be pulled from those wells and the well turned over to the City of Arvada.

CHAIRMAN MUELLER: So the gas-gathering system will not be abandoned until the well work is completed?

THE WITNESS: That's correct. That's correct. We are currently in a gas recovery mode now and the gathering system is still operating, and we will continue, until gas production ceases out there, to operate the gathering system back to the plant.

I would like to also talk about the four shaft sealing systems that are the seal systems in the original mining shafts. They operate essentially like wells, and those wellbores will also be abandoned. They are not -- we don't plan to do the same type of cement or the cement evaluation since those wellbores are a part of construction. They were never really drilled, they were more constructed as the shafts were being installed. So, the abandonment is simply, at the appropriate time, which is outlined in the plan, those wellbores will simply be cemented shut.

I've covered a couple of the sections there at once, and the plan gives a fairly explicit detail on each of the individual wells as far as the abandonment procedure and rough timing of when the well would be available for abandonment. At the time that we are finished with the gas recovery operations, we would then abandon the gathering system. The gathering system is comprised of buried steel pipe, ranging in size from 4 inches to 20 inches in diameter. All of that gathering system, and the plan addresses -- identifies a point in the gathering system called the, "K valve," which is a valve that's just to the east edge of the facility. So, everything from that point to the west will be abandoned. This is a standard abandonment for a utility company to abandon steel lines in place. You dig up any -- any location where the buried system meets aboveground facilities, the aboveground facilities are removed. The underground lines are purged of natural gas with an inert gas, and the ends of the lines are sealed.

We recently, in our ongoing conversations with the City of Arvada, the city would like an opportunity to possibly use some of these lines, if they are appropriate, in their water storage operations, and there may be some opportunity for them to use them, essentially, as casings to insert lines inside them to get across roads and for other uses in their water storage operations. So, we'll be working, on an ongoing basis, with the city as any of these abandonments take place.

The -- as the wells are abandoned, according to the Commission rules and also subject to our individual leases with the landowners, the wellheads and surface facilities east of the wells will be cleaned up and restored to the -- to an acceptable condition. The fences will be removed. All aboveground facilities, the pipe yards that -- we operate a pipe yard and storage facility just to the south of Leyden Road. That facility will all be cleaned up and removed and surface restored. The area does contain remnants of concrete buildings from the mining area. It's not our intent to disturb or otherwise remove any of the artifacts or relics from the mining area that were not a part of the gas storage facility.

The next piece I would like to talk about briefly is the post-closure monitoring. The post-closure -- we currently do some monitoring work with a variety of wells and other investigations in the field. First, we simply walk the surface along four different courses over the cavern and along the west perimeter with gas detection equipment. We're currently doing that on a four-time-a-year basis. That will continue all of the way through the period of post-closure. We have a variety of different monitoring wells around the perimeter of the field. We have several wells that measure the water level in the Fox Hills Aquifer.

We have two wells, Well No. 31, and Well No. 36, that have some storage gas in them. Those wells -- those gas occurrences are being depleted and will continue to be depleted until effectively that gas is gone. The monitoring activities of measuring water, measuring soil gas, will continue as long as the wells are operating. At the time that the water has filled the final well, and the structurally highest well is Well No. 9, at the time that the water fills that well, and it's ready for abandonment, begins a clock of 24 months for a period that we will continue to do the soil gas monitoring and the monitoring efforts in Well 36, Well 33, and now Well 34. So, it's a 24-month period beyond the time that water reaches -- that water injection into the facility is essentially complete.

Q Mr. Uding, could you indicate where Well 34 is on that map?

A This is Well 34.

Q That's the additional well that's, I believe, marked in red now that the company recommend be marked in green?

A Yes.

Q Have you gone through the entire plan, Mr. Uding?

A I guess the only thing that remains is, at the end of the monitoring -- the post-closure monitoring period, the remaining three wells would then be abandoned, subject to review by the city as in all wells. Before we do a final abandonment, we check again with the city to see if the city is interested in acquiring those wells. But beyond the period of abandonment, or beyond the period of closure monitoring, those wells would also be abandoned in the same manner.

Q Mr. Uding, could you discuss the recommendation that the company is making, in conjunction with one of its experts, that the Commission request that the State Engineer's Office condition its issuance of water permits in the vicinity of the Leyden Mine?

A Yes. It was a recommendation of one of our experts that future water well drilling be conditioned with our -- it was a recommendation to this Commission that this Commission normally request that the State Engineer's Office condition future water well permits within one-half mile of, essentially, our green property, one-half mile perimeter around that be conditioned with the requirement of blowout prevention equipment.

It was a finding of the geologists' work that -- the recent geologic work that potentially the Lower Laramie sands, very closely confined to this facility, would possibly contain some storage gas.

This is a similar condition that we found in Well 36 and Well 31. The geology that is now -- that we now know about the facility, we're much more confident that these sands are very limited in aerial extent. And the potential for migration from this facility is very small and would be a very short distance. We are asking that this be done only in an excess of caution.

Q Does the State Engineer's Office now cooperate with Public Service in issuing well permits?

A We currently have a letter of understanding with the State Engineer's Office where any application for a water well, within one mile of the facility, they ask that the applicant -- the State Engineer's Office notify Public Service and ask that the water well applicant contact Public Service Company.

Q And would the company be willing to continue that procedure?

A Absolutely.

Q Mr. Uding, let's move to the subject of the volume of lost and unaccounted for gas at this facility. There's been lots of reports over the years by individuals that there are potentially billions of cubic feet of gas lost underground. Would you address that question, please.

A Yes. I would be delighted to. I have two additional exhibits. This photograph is Exhibit A-3, and this plot is marked as Exhibit A-2. Throughout our 43 years of operating history, Public Service has injected more than 90 billion cubic feet and injected and withdrawn more than 90 billion cubic feet of gas into this facility. During that period of time, we have made accounting adjustments to our book volume totalling just over 33 billion cubic feet.

So, initially, to set the stage, just over 3 percent of the volume that was resident in the facility was reported as lost and unaccounted for. Lost and unaccounted for gas does not mean gas that was injected in the facility and then lost by means of leakage or migration or being absorbed into the surrounding rock. That is not what lost and unaccounted for is. Lost and unaccounted for is a correction to our accounting number, our booked volume.

In 1960, when the facility was constructed, the metering that was installed at the facility was designed primarily to measure very high rates of gas being injected or withdrawn. Exhibit A-3 is a photograph of those meters. We have three orifice meter runs. Furthest one in the photograph is the 16 inch -- 16 inch diameter orifice run and the closer two originally were 20-inch diameter orifice runs. These meters have inaccuracy, under the best of conditions, of 2 to 3 percent. They were never designed and never maintained as custody transfer meters. A meter facility for custody transfer, where we would actually be buying or selling gas, would be constructed substantially differently. You try to cover all flowing ranges. That was never done at this facility. We were only covering the high ranges.

About three months ago, we modified one of the meter runs in order to get a better handle on the last phase of our gas recovery operations, so the 20-inch -- one of the 20-inch meter runs was modified for the use of metering by installing a 6-inch meter run. The effect of this has been to give us much better data recently. This was the largest, we feel, the largest single issue with lost and unaccounted for was the metering.

In addition, there are other factors that are very much outside of gas being simply lost. As the gas flowed into and out of this facility, the first thing that would happen, as the gas enters the facility, is it goes through the metering. Beyond that, it flows through gas compression equipment, gas conditioning and processing equipment, and finally to the wells and into the storage field. On withdrawal, the gas then came back through all of the gas processing equipment, the gas compression, and it was a very -- if you remember from our visit out there, it's a fairly large plant. We have 10 compressor units for a total of 17,000 horsepower. All of the gas that was used to power the plants, the gas conditioning equipment, even the compression fuel was taken from the inventory. It is a part -- the company-used gas was a part of the figures that was reported as L&U, so the 3 billion cubic feet contains a portion of the company-used gas.

In addition to the plant-used gas, the gathering lines were occasionally cleaned. We had to purge the gathering line operation of this facility, which collected a fair amount of solid material from the mine workings in the gathering systems. Those large gathering lines had to be purged with natural gas. That gas was a part of the L&U figure. And the field-use gases for testing and powering of the separators in the field was also a part of that figure. So, rather than try to estimate or meter all of these different uses, it was all just collected together and reported as the lost/unaccounted for figure, along with the corrections that we can tell were necessary due to the style of metering that we were performing. In the recent history, we feel we have a much better handle on both the gas that will remain in the facility -- the gas that's currently in the facility and the gas that will remain in the facility.

Exhibit A-2 is a plot of the daily volume and the daily surface pressure of the facility. Shown in black, the small black diamonds are about four years of previous history on a daily basis. So, from September 1st, '96 through September 30th of 2001, our daily operating data is shown in black. The estimates of the gas in the field that we were performing are essentially volumetric, where, if things were in an ideal world, those black dots would line up to a single line. Shown in red is the operating data that -- the daily pressure and volumes since the last injection.

So, since October 1st of 2001, to present -- I think we have data here through the end of July of this year, and with the substantially better metering, and the fact that we are not reversing the direction of gas flow in the field has given us much better data with which to make calculations of volume remaining in the field. So, we're seeing a much easier to interpret set of data in the recent history, and we feel now that we have a very good handle on the gas volumes that are in the field.

Q Mr. Uding, did any of the experts use this more reliable data in formulating their opinions in this case?

A Yes, they did. Dave Cox is our petroleum engineering expert. He, among other things, has made a calculation of the gas that will remain in the field after the closure process is completed. This data has given him the ability to make a much more concise estimate than was previously available. The data is -- previous data simply didn't lend itself to precise calculation as it does now.

Q Mr. Uding, you mentioned that a portion of the lost/unaccounted for volumes that the company records for book purposes is including fuel used in compressors.

A Yes.

Q What's the horsepower of the compressors out at the Leyden site?

A There are 10 compression units for a total of 17,000 horsepower.

Q And the sole fuel for running those compressor engines is natural gas?

A Natural gas. They are all natural-gas-fired engines.

Q For a point clarification, on Exhibit A-3, that's a current picture that actually shows the modification of the measuring facilities?

A Yes. This photograph was taken just a couple of weeks ago. And, again, this is the 6-inch meter run that was installed about three months ago.

Q Last thing, Mr. Uding, with your renewed confidence with regard to the reliable data, is there any part of the closure plan you wish to address, to maybe modify the opinion that was expressed in it?

A Yes. When the closure plan was first drafted, we did not have available, first, the good data that we have. Since the time the plan was written, and the additional work of several of our experts, including our geologist, we made a statement in the closure plan -- I believe it is on page 5 -- page 5, Section D, we make the statement -- if I can find it.

We made the statement that it is virtually impossible to quantify, with any degree of accuracy, at the end of the closure procedure effectively how much gas may remain in the storage field. Now we feel that we can give a fairly accurate estimate of the volume of gas that will remain in the ground after closure.

Q Mr. Uding, in your expert opinion, do you believe the closure plan, with the additions that you've discussed, will protect the public health, safety and welfare, including the environment?

A Yes, I do.

Q Thank you, Mr. Uding. Does that conclude your testimony?

A Yes.

MR. ALBRIGHT: Mr. Chairman, I would tender Mr. Uding for any questions by the Commissioners at this time.

CHAIRMAN MUELLER: Okay. I know I have several questions. I think the other commissioners do as well. Just looking at the timing, it's 12:10 right now.

MS. BEAVER: I am going to try to locate the lunches. I understood they were to be delivered at noon, but it's 10 after.

CHAIRMAN MUELLER: Okay. Why don't we go ahead and get started with some questions, and -- nothing?

MS. BEAVER: No. I'm going to make a phone call.

CHAIRMAN MUELLER: Why don't we go till 12:30 -- and we'll take a break -- with our questions.

MR. ALBRIGHT: Mr. Chairman, Mr. Fowke is currently residing in Minnesota, and I believe he's got travel plans later this week, but his testimony will last probably about 10 minutes. So, if we could get him on, we can free up his time to do some important things he has to do the rest of the day.

CHAIRMAN MUELLER: Okay. Are you proposing, then, to have him testify now and then get back to Mr. Uding?

MR. ALBRIGHT: Yeah. Public Service's preference would be at least getting him before lunch, if we could.

CHAIRMAN MUELLER: Why don't we -- that's all right. Let's go ahead and do that.

MR. ALBRIGHT: Public Service Company would call Mr. Ben Fowke.

MR. UDING: I'll leave these here.

MR. ALBRIGHT: Good. I will handle Mr. Fowke.

EXAMINATION

BY MR. ALBRIGHT:

Q Could you state your full name and business address for the record.

A My name is Benjamin G.S. Fowke, the III. My business address is 800 Nicollet Mall, Minneapolis, Minnesota.

Q And by whom are you employed and in what capacity?

A I am employed by Xcel Energy Service, Inc. I am the vice president and treasurer for Xcel Energy and its subsidiaries, including Public Service Company of Colorado.

Q Now, who is Xcel Energy in relation to Public Service?

A Xcel Energy is the parent company of Public Service Company. Xcel Energy is a registered holding company and also owns interest in Southwestern Public Service Company and Northern States Power, both regulated utilities.

Q Who are you representing at this proceeding, Mr. Fowke?

A I am testifying on behalf of the Public Service Company of Colorado.

Q And could you just summarize your qualifications and education and responsibilities?

A Yes. I have a degree, a BS in accounting and finance from Towson University in 1981. I have a CPA certificate in Maryland, 1982. I've been in the industry about 20 years, and in various financial roles. I've been with Xcel Energy and its predecessor company for about seven years, in various financial roles. The last role was the vice president and treasurer role, which I took over in November 6, last year.

Q And just to make sure the record is clear, you were sworn in earlier today?

A Yes, I was.

Q You stated you are currently vice president and treasurer of Public Service Company of Colorado?

A That's correct.

Q What is the purpose of your testimony today?

A The purpose of my testimony today is to give the Commission assurance that Public Service Company of Colorado can meet the financial obligations that may arise out of this hearing, including or specifically related to the Leyden Gas Storage Facility.

Q Could you just give a brief description of Public Service Company of Colorado, Mr. Fowke.

A Sure. Public Service Company of Colorado is a Colorado corp. We are -- we have 1.2 million electric customers, or, rather, 1.3 million electric customers, about 1.2 million natural gas customers, and, as such, we are engaged in the generation, purchase and distribution of electricity, and in the purchase and distribution of natural gas in the State of Colorado.

Public Service was incorporated in 1924, and actually, the predecessor company, we can trace our roots in Denver as far back as 1869.

Q Could you give, roughly, a size of the parent company of Public Service Company, Xcel Energy, Inc.?

A Yes. As of the end of 2002, we had roughly revenues of 9.5 billion, assets of 27 billion. As of the latest Fortune 500 listing, we ranked about 184th. Our market cap, as measured as of Friday, was approximately $5.8 billion, and we are a New York Stock Exchange listed company.

Q Did, Mr. Fowke, Public Service file with the Commission, along with its application in this docket, on March 3, a guaranty of its performance of obligations in connection with the application?

A Yes, it did.

Q And in support of that guaranty, did the company submit excerpts from its 2002 10K?

A Yes, it did.

Q Mr. Fowke, before you is a document

marked as Exhibit A-4. Can you tell me what that document is?

A This is the Form 10K filed with the SEC on February 26th of this year, on behalf of the Public Service Company of Colorado and three other Excel operating utilities.

Q So, this is the complete 10K that was used?

A Yes.

Q So, to support the general --

A Yes.

Q The performance guaranty?

A Yes.

(Whereupon Exhibit No. A-4 was marked for identification.)

MR. ALBRIGHT: Mr. Chairman, I would move for the admission of Exhibit A-4 at this time.

CHAIRMAN MUELLER: Just to be clear, the 10K is A-4?

MR. ALBRIGHT: Yes, Your Honor.

CHAIRMAN MUELLER: Okay. Yes.

(Whereupon Exhibit No. A-4 was admitted.)

BY MR. ALBRIGHT:

Q Mr. Fowke, what's the net worth of Public

Service Company of Colorado?

A As of December 31st, of 2002, it was just slightly under $2 billion, and that calculation is made by taking assets less liabilities.

Q What are Public Service Company's annual revenues and total assets?

A Total assets are about 5.9 million. Revenues in 2002 were slightly under $2.7 billion.

Q And of those revenues and assets, what portion is attributable to Public Service Company's regulated businesses?

A Substantially all of it. More than 98 percent of it's related to the regulated operations.

Q And where are those operations and those assets located?

A Virtually all of Public Service's physical assets are located in the State of Colorado.

Q And just briefly, what's the nature of Public Service's businesses in Colorado?

A We are the largest electric and gas utility in the State of Colorado. We're regulated by the Colorado Public Utilities Commission, as well as other state and federal agencies. And as I mentioned previously, we're an integrated regulated utility.

Q What type of region does that include, Mr. Fowke, with respect to the Public Utilities Commission?

A Public Service is regulated, their rates and facilities, by the PUC. Our ability to issue securities to the public markets are regulated by the PUC. And, in addition, the PUC must approve any sale of transfer of Public Service's assets.

Q So, Public Service can't leave the state without getting approval from the State of Colorado?

A No.

Q As a regulated public utility, is Public Service often have obligations to comply -- or provide other specific assurance to comply with the rules and regulations of the PUC?

A No -- I mean we are -- as I mentioned earlier, 98 percent of our business and revenues come from our regulated operations. And, as such, regulatory compliance is pretty much, you know, standard business, and something we have to do. So -- and in order to pass costs off on this, the cost associated with the Leyden closure being one example, we have to be in compliance with all of the regulatory rules, so we have every interest to comply.

Q So, just to confirm, for Public Service Company to actually recover the costs associated with closing the Leyden Facility, it's required by the PUC to comply with all applicable laws and regulations?

A That's correct.

Q Mr. Fowke, in your opinion, is Public Service's guaranty of performance provided in this case sufficient assurance of Public Service's fulfillment of its obligations in connection with the closure plan?

A Yes, it is.

Q Does that conclude your testimony, Mr. Fowke?

A Yes, it does.

MR. ALBRIGHT: I would tender Mr. Fowke for any questions by the Commissioners at this time, Mr. Chairman.

CHAIRMAN MUELLER: Thank you. Commissioners, any questions?

COMMISSIONER CREE: Is Public Service -- is it a wholly owned subsidiary of Xcel?

THE WITNESS: Yes.

CHAIRMAN MUELLER: Tom.

COMMISSIONER REAGAN: The guaranty that Public Service is making is a blanket guaranty? It's not limited in dollar amount?

THE WITNESS: I don't believe it's limited in dollars.

COMMISSIONER CREE: So, just looking at your -- at Public Service's consolidated statements of income for 2002, year-end December 31, it looks like Public Service made about $265 million. If you add back interest and depreciation and cash flow, it was maybe half a billion dollars.

THE WITNESS: That's roughly about right. Of course, then you have the capital expenditures that would go into that as well for all --

COMMISSIONER CREE: Seems like a pretty solid company.

THE WITNESS: We think so.

CHAIRMAN MUELLER: Thank you for coming all of the way. I do have a couple of questions. Right now, there are two bonds that have been posted. Do we know how much they are for?

MS. BEAVER: 50,000 and 30,000.

CHAIRMAN MUELLER: One is for the plugging.

MS. BEAVER: (Nodding head in the affirmative.)

CHAIRMAN MUELLER: The other is --

MS. BEAVER: For the facility.

CHAIRMAN MUELLER: Okay. And as I understand, the total cost of closure is estimated to be somewhere between 6 and $9 million?

MR. ALBRIGHT: (Nodding head in the affirmative.)

MR. UDING: (Nodding head in the affirmative.)

MR. ALBRIGHT: That's the current estimate, Mr. Chairman.

CHAIRMAN MUELLER: Okay. And last question is, if in this day of buying and selling assets, should Public Service Company be sold, would the obligation remain with Public Service Company or with the parent company?

THE WITNESS: It would -- well, the obligation stays with Public Service of Colorado.

CHAIRMAN MUELLER: Thank you. Any more questions from the Commissioners?

COMMISSIONER CASEY: (Shaking head in the negative.)

CHAIRMAN MUELLER: Okay. Thank you very much, sir.

THE WITNESS: Thank you.

CHAIRMAN MUELLER: Have a good trip.

(Lunch recess.)

CHAIRMAN MUELLER: Okay. We're back in session.

MR. ALBRIGHT: Mr. Chairman, as a preliminary matter, Public Service would, at this time, wish to move into evidence Mr. Uding's Exhibits A-1, A-2, A-3, as well as his resume at this time.

CHAIRMAN MUELLER: Okay. Thank you.

(Whereupon Exhibits A-1, A-2 and A-3 were admitted.)

CHAIRMAN MUELLER: I believe most, if not all of the Commissioners have questions for you, Mr. Uding. So, I would like to just go ahead and start with Commissioner Reagan.

EXAMINATION

BY COMMISSIONER REAGAN:

Q Let's talk for a minute about your gas-in-place exhibit there. You attribute for the -- its accuracy to the fact that the flow of gas is only out of the reservoir now; that you are using better metering equipment in terms of surface pressures.

A The metering equipment that I was addressing was the gas meters that measure the volume.

Q Volumes.

A So, that measurement has improved appreciably over the last three months. The pressure measurement, that was the large dispersion of data on the plot, is due to the frequent injection/withdrawal nature while we were operating. So, immediately following an injection of any appreciable amount of gas, there would be an injection and then a shut-in. There would be a period while -- that the pressure slowly fell off. And, likewise, following withdrawal, there would be a period of building up and that period would typically not complete itself, not resolve to hit a stable pressure before the next activity was upon us. So, we were always in a state of a transient, so to speak, pressure response. It was difficult to pick a pressure that represented a stable reservoir pressure for all of the area that contained natural gas.

And to answer your question, yes, since September 30th of 2001, we have only withdrawn gas and have had periods where the reservoir has been shut-in for a length of time without any activity. And so, both the pressure measurement and the volume measurement have improved substantially over the last little bit of operations.

Q Okay. One question about the actual -- the meters themselves. You said you are using standard orifice meters. Are you using digital calculation or how do you interpret the orifice charts? Are you even using charts?

A Yes. The orifice meters -- the gas

volume meters are orifice meters, and the, excuse me, I believe -- and I am not the metering expert so I can tell you what I know of the meters.

Q All right.

A Differential and static pressure are recorded on paper charts and --

Q Paper charts?

A They are integrated with the rest of our orifice meters.

Q Okay.

COMMISSIONER REAGAN: I have no other questions.

EXAMINATION

BY COMMISSIONER SHOOK:

Q One always hesitates to ask questions for fear of showing ignorance, but I do have two or three quick questions. I believe that you used a figure of 3 billion cubic feet in referring to the maximum gas injected at one time into the mine?

A Yes. The reservoir at full capacity would hold roughly 3 billion.

Q About 3 billion?

A Yes.

Q And then you also used the figure of 2 billion cubic feet as being the, "unaccounted and lost"?

A Since operations have started.

Q Right.

A In 1960 to present, there's been just over 3 billion feet of lost and unaccounted for gas. If I said 2 billion, I misspoke.

Q It was over -- okay. Over 3 billion, then?

A Right at 3 billion, yes.

Q And then one of the places that you said that -- one of the main places for the unaccounted and lost gas was in -- by the use of pumps, the compressor pumps and so on?

A The gas compression equipment is gas-fired equipment.

Q Uses gas out at the mine?

A Yes.

Q Are logs of hours of operation kept on those compressor pumps?

A Yes, they are.

Q Okay. Have you -- and do you have any knowledge of the approximate use of gas per hour by these compressor pumps?

A That knowledge, yes.

Q So, then you have logs of hours of

operation and knowledge of the amount of gas use per hour, you should be able to calculate the total amount of gas used by the compressor pumps?

A Yes. That calculation could be done and I believe that -- there are 10 compressor units out there. There are seven reciprocating compressors and three turbine units. And some of the compressors are on header, where the fuel gas is actually metered with the separate meter.

So, we have, as a part of the total metering of the facility, a separate meter, not these guys, but a smaller plant meter that meters a portion of the fuel gas that goes to the compression. So, there is an accounting chain where that fuel is accounted, but it -- that measured volume for those units was never subtracted by the accounting folks from the inventoried volume. And so, while it was measured, it was never applied or charged against the volume that was carried on the books as gas-in-storage. So, those volumes had to be lumped in with the other uses as lost and unaccounted for gas.

Q So, you cannot give us any figure then?

A As I sit here today, I can't. We can, you know, as far back as records go -- and I'm not certain how far back -- that compressor use or compressor hours or horsepower hours are kept, but ideally, I guess a calculation of that nature could be constructed.

Q And it would be interesting to know, you know, an approximate figure, given the fact that you're using this as one of the major factors for the unaccounted for gas.

COMMISSIONER REAGAN: That's all I have.

EXAMINATION

BY COMMISSIONER CREE:

Q Let me expand on that a little bit more, because I think that, at least from where I sit, and I would think that from where many of the residents -- one of the concerns that we've heard is, jeez, you put 90 in, you are going to be getting 87 out and there's 3 missing. And it sounds like a lot. I mean, I know from my days, when you are integrating charts and trying to do those measures, being 2 or 3 or 5 percent off is not a big thing. I mean, that's pretty reasonable.

And if there was some way for you guys to get go a very quick analysis, hey, these 10 compressor stations average about this much gas a day and they have been running for this long. I mean, if you could come back and just show some mitigation that said, of this 3 BCF that we're missing, there's a good chance that 2.5 of that was used in service. That might be really valuable information and might start to alleviate a lot of the fears.

Because I think, when everyone says, we hear 3 BCF is unaccounted for, then they think it's somewhere out there outside of the cavern and underneath their house. And it's just a big number. Now, it's not that big of a number. And, you know, like I said, from my standpoint, understanding how you did it, hey, there's -- it's pretty reasonable that it could be 2, 3, 4 percent off. It could be 2, 3, 4 percent off the other way too. You don't really know.

If you had -- just had some way of trying to quantify those things here, that might really help if I was sitting in their shoes. That would help me if you said, hey, it's pretty reasonable that maybe 2 1/2 BCF of that was used. Now you come back and say, jeez, the compressors don't use anywhere near that amount. It's really only half of a BCF. Then you still have to come up with some way of explaining the other 2 1/2.

So, is that possible at all? I think that would be really helpful. If not, you know, so be it. That's the information we have got. I wanted to just expand on that for a minute. That was going to be one of the same questions I had.

A couple of other things, and then I'll be done, is you talk about some plan additions that you made, based on expert recommendations. You took the initiative to say, hey, we're going to do some of these other things because the experts recommended them, and we think they make sense. My question to you, was there -- were there any other recommendations made by those experts that you guys said, huh, I don't really want to go to that extent to do -- or we don't want to do anything else.

A The process of using our experts was -- I enjoyed it this time. It was very informative for all of us. It's the first time I have had such a broad group of experts that actually worked together. And so, when each of the independent experts produced their report, they all had a small shopping list of issues that they wanted to talk about. And several times during the process, we got together where all of us were there and all discussed, you know, everything they had.

And the recommendations that we are adopting are all of them that remained. Some of them had issues during the process that they felt were satisfied before they got to the point of a final recommendation. So, yeah, people did come up with things that they thought were appropriate. But, by the time it was all talked out and everyone had an opportunity to hear everybody else, we felt fairly certain that we were covering everything that each of the experts would like to have.

Q Great. So we can ask the experts that. Hopefully we'll hear from them.

A That's the expectation.

Q The other question is that you talked about the wells that you will plug and abandon. I am assuming -- maybe you said it -- but I'm assuming that you will P&A those wells under the rules of the state and under our regulations and comply with those to the fullest extent?

A At least as minimum standards.

Q Excellent. Let me see.

COMMISSIONER CREE: Thank you. That's all I got. Thank you.

CHAIRMAN MUELLER: Okay.

EXAMINATION

BY CHAIRMAN MUELLER:

Q Mr. Uding, I have more than a few. Maybe we can get through this fairly quickly. I guess, first up, standing back from this a little bit, can you give us a sense as to the time frame of the closure and the post-closure monitoring? In other words, do you think you can break down the closure into segments and give us a sense as to how long each of those will run?

A Okay. I think the next step from today is the approval by this Commission of the plan, with your approval, that sets the stage for the city of Arvada to begin their operations and preparations to inject water into the facility, I believe -- and Mark is here to answer some of the questions that are more specific to that, but once we have the approval of the closure plan, they can relatively quickly construct a pipeline to begin injecting water. Largely, the entire closure process is based on the availability of water to accomplish the flooding of the caverns.

We anticipate, based on what we hear from the City of Arvada, that is likely to take about 2 years to 2 1/2 years. And, again, no one knows how much water is coming out of the mountains in any year, but we believe 2 to 2 1/2 years to have the water available and to get it into the caverns. As the water is being injected, the abandonment procedure for the individual wells -- and this is outlined in the plan -- as those wells flood out, as the water comes into the -- into the casing, we can begin the process of abandoning that individual well. So, as the cavern is being flooded, we'll begin abandoning these wells up to the last well numbers, which will be the last one flooded out. When that well has water in the casing shoe, it starts a two-year clock for the post-closure monitoring activities.

So, 2 to 2 1/2 years to get to a, basically, full cavern, which starts the post-closure monitoring, two years of post-closure monitoring, and then the final abandonment of those wells. The other pipeline abandonments and surface restorations are just going to go on as the flooding continues.

Q So, somewhere maybe five years total, again, depending on the ability to fill the cavern with water?

A Correct. But we expect the majority of activity -- the majority of the abandonments and everything to take place within 2 1/2 years. We hoped it would be completely finished by 2005, by the end of 2005. It looks like our post-closure monitoring is going to go beyond 2005, but largely things will be finished before 2006.

Q Okay. Thank you. Then, you made a statement that when Public Service Company began to convert the facility to water -- or to gas storage, it was found mostly full of water?

A Yes, it was.

Q How long had the facility been shutdown at that point, as far as mining operations?

A The mining operations, that's kind of a two-part answer. The east cavern, or the upper A seam mines ceased in 1917. So, this had been abandoned from 1917. The west cavern was abandoned in March of 1950. We arrived on the scene and began the actual drilling operation in '59. So it was nine years.

Q Okay. Has there been a monitoring of the surface levels looking for subsidence or basically any change in the surface levels during the operation of the facility?

A Um, it has not been a part of our regular monitoring effort. They do visual inspections of the entire field once a week, the operators do. We have a couple of times during this, its operating history, had outside consultants who evaluated for subsidence. Some of those evaluations included some fieldwork. And as a part of closure activity, we had a fairly comprehensive review of subsidence. That's one of our experts.

Q Okay. How is -- what's the activity at the facility right now as far as the withdrawal amounts and the -- we have pressure information up on your plot. Right now looks like it's somewhere in the 40 psi range.

A We are -- this week we're right at 39 pounds. We're currently producing gas five days a week, 24 hours a day, five days a week. The withdrawal operations are coupled with compression because we're -- the gas that comes out of the facility has to go into a high pressure distribution system, so it has to be compressed -- processed and compressed. So, that operation requires round-the-clock staff, and we only have enough staff to operate the facility five days a week. So, we're basically shut-in over the weekend. From Friday evening until Monday morning, we're shut-in. It also gives us an opportunity to get a two day shut-in pressure reading every Monday morning.

All of the wells that are connected to the gathering system are open for production, although only a few of them are flowing. So, we are producing gas technically out of all of the gas wells. We're currently making about 1,000 MCF per day from the entire facility. The compression runs down to somewhere in the 15 to 20 pound compressor inlet pressure, so our driving force is 39 pounds down to sometimes 15 pounds.

Q You also made a statement as to the three additions to the plan or changes to the plan. The future water wells drilled in the area, you would like to see blowout preventer equipment added to those permits as part of the condition. As part of that, and the cost for that, is Public Service Company planning to bear that extra cost?

A That's not a part of our plan at this time. I guess that that can possibly be an issue that's worked out with the State Engineer's Office or this Commission.

Q Pardon me if this is not the right question for you, but let me ask you it anyway. One of the things that has come up has been this concern about the diminution of water well drilling rights or removal of water well drilling rights. From what I understand, in reading through the various materials, it sounds like -- and the information from the Department of Water Resources, there's a process that was discussed earlier where there's, really, there have been no rights taken away. It's simply a process where an individual would contact Public Service Company to review their drilling plan before it went to the state for final approval; is that correct, from your perspective?

A That's my understanding of how the

process works now, yes.

Q How many water wells, do you know, have been -- have gone through that process since you've been involved with the facility? Do you know?

A Since the facility has been under my charge, I've been contacted one time about water well drilling in this area.

Q And was that well drilled, do you know?

A No, they weren't.

Q Was that contact recent?

A 1995.

Q I guess, depending on your age, that would be recent. You also made a discussion -- or the point before lunch that you're now able to estimate the amount of remaining gas-in-place that will be recovered.

A We feel we have a pretty good handle of gas-in-place as of this date. And we also have a very reasonable handle on how much gas is going to be left in the facility when no more gas can be produced.

Q And can you give us that?

A Dave Cox is going to outline that in great detail.

Q Okay. And I guess the last point is, I would second the request for information as to the fuel used in those compressors, if you are able to come up with an estimate.

A I can tell you that, at least in the more recent history, and that being mid-'80s forwards, we can produce those figures. I'm uncertain how far back these type of records are kept. So, possibly we can make a comparative basis from this moment forward.

Q A good engineering estimate.

COMMISSIONER REAGAN: I was going to say, it's possible to look at tables and to come up with a -- a gas consumption per horsepower hour?

THE WITNESS: Certainly.

COMMISSIONER REAGAN: You wouldn't really have to have the measured -- you just had to know how much horsepower you had running and if it was gas-fired, you ran it for 20 years, it's going to be a significant amount of gas, going to be a large amount of gas.

CHAIRMAN MUELLER: Yes.

COMMISSIONER SHOOK: I think that's the whole point.

CHAIRMAN MUELLER: Thank you.

EXAMINATION

BY COMMISSIONER KLISH:

Q Just a couple of things. Is there any

water in the caverns now, and, if so, how much?

A Yes. There's a fair amount of water in the bottom of the cavern now. Um, I don't know that I have a precise estimate or a reasonable estimate of how much water, but, in very rough terms, about 1/3 of the cavern space is full of water now. Throughout our entire operating history, we pumped in an average of somewhere between 30 to 50 gallons per minute during the entire life of the facility. That operation stopped in the early part of this year. Even when that operation had stopped, there was a fair amount of water in the bottom of the cavern.

Q And part of your amendment here to your plan is you are going to add a third monitoring well that was going to be P&A'd?

A All of the -- one of the existing monitoring wells, No. 34.

Q Right.

A That the closure plan says could be abandoned when the facility is full of water. And what we're saying now is we will continue operating that as a monitor well for 24 months past that point.

Q And that was added back in --

A At the recommendation of one of our consultants.

Q And we'll hear more about that.

COMMISSIONER KLISH: Okay.

COMMISSIONER CASEY: I just have a couple questions.

EXAMINATION

BY COMMISSIONER CASEY:

Q Can you hear me okay?

A Yes.

Q You added three new conditions into the permit. Are you going to give us some documentation of this or --

MR. ALBRIGHT: Mr. Chairman, the Commissioner's question relates to the three additions to the plan. We do have those written up. I am not sure we are prepared to submit them today, but at least by tomorrow, we could submit those to the Commission.

CHAIRMAN MUELLER: Would you, please.

MR. ALBRIGHT: Sure.

BY COMMISSIONER CASEY:

Q On your Public Service -- in the plan, on page 12, it talks about -- you probably know what this is.

A Okay.

Q But it talks about you -- the plan is to continue the maintenance of the shafts until the gas pressure in the caverns fall below 40 psig.

A Yes.

Q Where did the -- I was curious how you came up with 40 pounds per square inch, and kind of how that fits with what's going on now. The pressure is lower than that now?

A Yes. The pressure is just very recently lower than that now, in that I guess we -- I was working with our field operations, because they are the ones that have to continuously go to these shafts, circulate them with a pump, and add mud material to them. And the 40 psi was probably just not a figure that came from my direct engineering work.

I can tell you, by practice, that they are continuing to maintain those shafts, and when they call me to ask me if they can stop yet, the answer is no. It's my current intent to have them continue maintaining those shafts until the water injection has the water level above the base of those shafts. So, at that point there's no gas opportunities to move through those shafts; and, therefore, the maintaining of mud seal would no longer be appropriate.

Q Okay. So, you weren't going to call it off at 40 psi?

A The original plan was that the water

injection would have already started by now. I mean, as we were looking at the original timetable, we had expected to be injecting water at a lower rate and therefore taking longer and still be engaged in gas withdrawal operations. That was just a development phase of the plan at the time, I mean.

Q I have one more question -- I had a couple more questions. Could you elaborate on exactly what you figured out, by installing the 6-inch meter run and comparing that to the larger meter runs that you have been using in the past?

A Certainly. Again, I am not a metering expert, but roughly the way an orifice meter works is the pipe runs -- roughly, the way an orifice meter works, it measures gas that moves through the pipeline. These -- the orifice meters are actually flat plates that are put into the flow of gas with a smaller diameter hole through the plates. When the gas moves across it, it creates a pressure loss or a differential, and based on the amount of differential and the pressure of that gas in the pipeline, from that, a volume is calculated.

In a very large meter run, these 20-inch meter runs, with very low flow rates, not enough differential is created to be able to distinguish how much -- you know, to be able to make an accurate calculation. Typically, these types of meters run on up to a 100-inch water column of differential, which is like three plus pounds of differential. In a very low flow rate, with a very large meter, we would have less than one inch of differential. So, much of the activity was, by standard, out of range of the meters.

So, you got a circular chart that you are recording the differential on. And the incline of the -- on the chart was larger -- was thicker than any response that you were trying to see on the chart. The way to get -- make that better is to force all of the gas, being at a low rate, through a much smaller orifice run, and therefore get a larger differential. So, this meter is more properly sized for the very low flow rates that we're dealing with right now.

This past set of large meter runs was designed to measure 240 million cubic feet per day of activity -- of withdrawal and now we're at basically 1 million feet of gas per day. So we're on the very out of range, out of lower range of measuring ability with the larger meters. And the smaller meters has given us much, much better metering.

Q So, is that mean, then, in the past, when you were using more gas, that those meters were more accurate, the original orifice meters?

A At the very high rates, these meters were reasonably accurate. Much of the activity during the life of the facility was not at those high rates, particularly in the last 8 to 10 years. When the gas business changed, the facility changed from being, simply, it's 10 degrees below zero, so let's bring all of the gas that we can out, and in a very high rate of withdrawal. The facility was used for contract balancing, so, for a few hours, we would have an opportunity to buy inexpensive gas, and this was, you know, a place to put that gas, so, activities happen rapidly back and forth at very low rates. But nonetheless, a lot of activity.

Q Did you do a comparison with, say, what your calculations were of gas going through the larger meter and then you changed out the meter, compare that to the -- what the smaller orifice was telling you and see -- did you have any idea, for example, that you were off by, you know, 5 percent you are underreporting or overreporting, or is there any opportunity to compare those different styles of meters?

A I'm not sure that we can make an apples and apples comparison because, again, much of the activity that was measured by the large meters was injection and withdrawal activities. And currently we're doing only withdrawal activity. When this meter was installed, I know that they immediately stopped using -- so we didn't have a period where we measured with both meters. And these runs are now out of service. I don't know that we could make a relevant study that would improve things much for us.

Q One more question -- well, two questions. Has anyone ever reported gas in their water wells surrounding the facility?

A No, not that I'm aware of.

Q And have you discussed with the state engineer the idea of installing blowout preventers on the gas or the water wells, as you recommend that people do in the future, within half mile?

A I have not had that discussion, no.

Q Well, we have a letter that states that they didn't think that they would support that. So, I was wondering if you had discussions to see if that was --

COMMISSIONER REAGAN: Excuse me.

BY COMMISSIONER CASEY:

Q Kind of a reasonable idea.

A We had a -- I've had some recent discussions with staff of the engineer's office to, I guess, explore what is in place now, because it was set up by one of my predecessors, which is the area that, when they had an application come in within that area, that they would refer the application to us for comment. And the discussions that I've had with them are about the processes that we're currently engaged in, but I have not had a discussion about blowout prevention equipment with them.

Q Thank you.

EXAMINATION

BY COMMISSIONER SHOOK:

Q I thought of a couple after other questions that were asked. No. 1, can you tell me what the pressure at maximum capacity was?

A Yeah. It was 250 pounds surface pressure.

Q At the top of your well?

A Yes.

Q And it's 39 now?

A It's 39 currently.

Q And what do you anticipate it being during flooding of the mine, at maximum?

A Um, it will never be above 39 pounds. So, it's currently at 39 pounds. And we are continuing to produce gas out and are following basically this track. So, as we continue to pull gas out, without any water injection, we will continue down this track. If water injection were to begin today, it wouldn't make a significant difference in the pressure, as long as we continue to take gas out. And so, they will begin adding water. We will continue taking gas out. So, it will be somewhere in this range. We'll continue taking gas out. As they add material to the reservoir, that would have the effect of supporting the pressure, but we don't think it would be enough -- their rates are not going to be high enough, and are so low that it will not actually make the pressure come back above what it is now. At the point that water has displaced all of the gas out, it would be simply the water pressure.

Q Okay. And one unrelated question. What is the minimum feet of overlay at the mine? Is it 700 feet? Is that what you said earlier?

A I believe, if you went to -- there's -- if you remember from the site visit, there's a significant amount of surface relief. I believe the lowest burial point is the bottom of Barbara Gulch, at the north edge of the No. 1 or the A seam mine. At that point, there's roughly 600 feet.

COMMISSIONER SHOOK: Okay. Thank you.

CHAIRMAN MUELLER: Any other questions? We're all learning from each other, so there may be a couple of rounds of this.

EXAMINATION

BY CHAIRMAN MUELLER:

Q Going back to water wells for a second. Do you have a sense as to how deep water wells are in this area?

A There are, so far, as I understand it -- and our hydrologist can address this in detail. There are a number of shallow wells that are 200 feet or less, and then some smaller number of deeper wells that take water from the Laramie-Fox Hills Aquifer. And those would range in the 800 to 1100 foot range.

Q Okay. And then skipping over to metering, are gas flows both ways through those meters? In other words, they are bi-directional meters?

A Yes, they are.

Q And do you have a sense of accuracy of bi-directional meters as compared to -- I realize you are not the metering guy.

A My experience is from another field, where it's even more of a problem, which is the Round Up Field. The bi-directional meters are less accurate than the uni-directional meters.

CHAIRMAN MUELLER: Thank you. Any other questions from the Commissioners? Thank you very much, Mr. Uding.

MR. KEEFE: Thank you, Mr. Chairman. We would like to call as our next witness, Dr. Robert J. Weimer, and it may take him a minute to get his exhibits set up. Will you indulge us for a moment?

Thank you, Mr. Chairman for indulging me for a minute.

CHAIRMAN MUELLER: No problem.

EXAMINATION

BY MR. KEEFE:

Q Would you please state your full name and address for the record.

A My name is Robert J. Weimer. I reside at 25853 Mt. Vernon Road in Golden. That's my business address as well.

Q Mr. Weimer, I'll refer you to the resume portion of the exhibit, please, and would note for the Commission that there is a copy of a resume attributed to you in that portion of the exhibit book, at the last portion of the exhibit booklet. And I would ask you, was this resume prepared by you?

A Yes.

Q And for the benefit of those present, who may not have seen your resume, I would ask you to highlight just a few of your qualifications as a geologist.

A I have a bachelor's and master's degree from the University of Wyoming in 1948 and '49. I have a PhD from Stanford University in 1953. My professional experience was five years as a geologist for the Union Oil Company of California, three years as a full-time consultant. Professor at the Colorado School of Mines in the Department of Geology and Geologic Engineering for 26 years. Then a Professor Emeritus and consultant for the last 20 years.

I've been certified as a professional geologist by the American Association of Petroleum Geologists, the American Institute of Professional Geologists. I am a registered engineer in the State of Colorado. I was elected a member of the National Academy of Engineering in 1992.

Q Dr. Weimer, would you give the Commission a brief description of your experience and expertise relative to the geology of the area in which the Leyden Facility is located?

A Well, I've done stratigraphic and structural studies of the formations in the Leyden Facility over the last 40 years. I published several papers about geologic formations in that area, and in the region from Morrison to Boulder, putting the Leyden Facility in a broader perspective than just those few square miles.

My interest first started about the time that Public Service Company started drilling injection wells, because we had been doing outcrop studies, and I was interested in seeing how those outcrops related to what was found in the wells. I think those first few wells were critical to tie the surface to the subsurface. I also had an opportunity to see the mine maps about that time as well, 40 years ago.

Q All right.

MR. KEEFE: Mr. Chairman, we would submit Dr. Weimer as an expert in geology for purposes of this hearing.

CHAIRMAN MUELLER: Yes. He's accepted as an expert.

MR. KEEFE: Thank you, Mr. Chairman.

BY MR. KEEFE:

Q Dr. Weimer, have you been retained by my law firm as a consultant and expert witness in connection with Public Service's application before this Commission?

A Yes. I was retained to analyze,

in-depth, the geology of the subsurface underlying both the Leyden Gas Storage Facility and surrounding lands, and to give my opinion concerning the adequacy of the closure plan submitted by Public Service Company, and in protecting the public health, safety and welfare and protecting the environment.

Q And, Dr. Weimer, did you prepare a report in connection with this application which explains in detail the geology of the area of the Leyden Facility as it relates to closure of the facility?

A Yes, I did.

MR. KEEFE: I would note for the Commission that you all received copies of this report. And in order to get it in the record, I will hand the reporter a copy as well. And I will ask her if she would mark it as Exhibit B-22.

(Whereupon Exhibit No. B-22 was marked for identification.)

BY MR. KEEFE:

Q All right, Dr. Weimer. And did you prepare or have you prepared, under your supervision and control, any exhibits to assist you in your testimony today?

A I have. And those are Exhibits B-1 through B-21.

Q All right. Before we get into some of the specifics of your report, could you tell the Commission what you focussed on, in particular, in order to arrive at your conclusion relative to the closure of the facility?

A I turn my attention first to structural geology in order to address the issues as to whether or not natural faults and related fractures intersect the mine area, and the extent of surface providing potential pathways for vertical migration of gas. I then considered the Cretaceous stratigraphy in order to determine what were the unique conditions for the origin of the Laramie Formation, from which resources have been produced.

Next, I examined the reservoir and seals for gas for the purpose of ascertaining whether the sandstone above and below the mine rubble zones are continuous and sheet-like, although they occur as lenticular and isolated lenses encased by impermeable claystones to prevent gas migration. And finally I did the stratigraphic model for integration and prediction. This was done in order to predict the occurrence thickness and aerial distribution of lenticular sandstones, for where storage gas may have migrated.

Q All right. Then, let's start with the

structural geology, which was the first part of your report. Could you please describe for the Commission what the structural geology is relative to the Leyden Facility?

A Yes. The Exhibit 1, which is the index map that you see here, is similar to what Bill Uding showed you on his Exhibit A-1. The outline in gray of the mine -- of the Leyden Facility is shown. I am going to show you, in Exhibit 2, the structural cross section that extends from the outcrop area at Leyden Gulch, to the east, past the town site of Leyden. That east-west section is shown here on Exhibit B-2, and it shows the structural geology has two main components. The first is along the Leyden ridge, on the west side of the area. The beds dip very steeply and are broken by faulting. Remember, those beds, at one time, were flat. They have been shoved up with uplift of the Front Range and then eroded to give these layers, so that we can study them on the surface.

The other aspects of this structure is the low dip that's involved in the area where the coal mining occurred, and now where gas storage takes place. This cross section, the B-2 exhibit, shows the position of the A coal and the B coal, both of which were mined, and the west edge of the Leyden Mine. The scale here is vertical scale equals the horizontal scale. It's what we call, "the true-scale cross section." The formations present on this structural cross section, the Pierre Shale, Fox Hills sandstone, the Laramie Formation, divided into two parts, the Lower Laramie that contains the coals, and sandstone and Upper Laramie, which has mainly a composition of impermeable claystone.

To depict the structural geology, then, of the mine area, this eastern part, I have Exhibit B-3, which shows lines of equal elevation on the base of the B coal zone, this coal zone here. And at the north edge of the Leyden Facility, the elevation of this B coal seam above sea level is 5100 feet. That's, as you recall, the structure contour at the line of equal elevation. That's what we call at the south end of the mined area. The elevation is 4800 feet above sea level. So, we can -- you can see that across two miles here, there's a south-southeast dip of about a degree and a half, about 300 feet.

The important thing to note here, as Mr. Uding pointed out, is water is present in the low structural position of this tilted block. It's a block that's tilted to the south. And above that, where gas has been injected, the gas is present in the high structural position. That's just by gravity separation, and then trapped along the north edge by termination of the mine, ending in unmined coal. That contour interval is 50 feet. You notice on there there's no faulting illustrated. That map was taken from Barrows in 1997.

I will show you two more detailed structure contour maps, which will expand on what I just commented on. The first is of the east mine, and this shows the mine workings on this map. This is B-4, Exhibit B-4. The contour lines here, lines of equal elevation, are shown across the mine area. The important thing to note on this exhibit is that these contour changes in elevation are every 5 feet. It's very unusual to see such a detailed structure contour map. The elevations were surveyed at the time the mine workings were active. As the workings were surveyed, elevations were carried as well. And mine personnel then connected lines of equal elevations by lines and those are the structure contour maps that we see now.

This is a very important map, because of the detail that's shown. It's some of the best geology that you could get, in fact, in terms of continuous layers. You'll note that no place on that map were any faults shown in the mine and that would be a very obvious thing with the mine coal thickness of the A seam being on the order of 7 feet. If you had an offset of a fault, of 5 feet or 10 feet, it would cause very serious dislocation in the mining operation. And that did not occur, according to these mine maps. This map was would have been prepared prior to 1917, for example.

Now, a seismic line was shot in 1992 by Geo-Recovery Systems, for about 2,000 feet, along the Barbara Gulch. It's called the GR-5 line. This line was totally above the area of the B seam, or where it had collapsed. And the seismic line was shot. There was also a soil gas analysis made from the shot holes as they were drilled. The people who interpreted the seismic line say that there were dislocations in a seismic reflection or at the level of the coal seam, the A seam. They had nine faults that they had plotted on that seismic section. And above the locations of some of those faults, they found some anomalous soil gas readings. And this led them to believe that, in fact, faults -- natural faults cut the coal seam and extended to the surface; and, therefore, gas leaked to the surface along those natural faults and fractures associated with it.

I think that, looking at the geology of

this mine map, that those conclusions are totally in error. There are no faults that have been recorded at the mine level by direct observations. And geophysical data represents indirect observations, so you could ask the question, then, what might have caused these dislocations in the reflecting a horizon. I think it could have been caused several ways, but my preferred explanation is that, as the seismic reflections are recorded, what you were seeing was dislocations relative to mined and unmined areas, because this is a room and pillar type of mining operation. That will be explained later by the mining expert.

Public Service has used this seismic technique to find the main passageways where they drill the injection wells. They didn't want to drill them into a pillar where, in fact, they did a couple of wells in a pillar and decided that they better use some system to better locate the openings.

In addition, in 1999, when the Observation Well 36 was drilled, two seismic lines were shot there, to make sure they could locate the south edge of the mined operations. And these two lines, the 9-1, 9-2, very clearly showed where areas were mined and unmined by the seismic data. So, I think there's a good explanation of what was observed on this seismic line, and it was not natural faulting.

Now, one other bit of information that relates to whether or not there's a connection from the pressure -- pressuring where gas was injected and the surface is Well No. 10, right at the end of that seismic line. Well No. 10 had a hydrograph metering the water level in the well for many years. And there was no indication that there was ever a connection from the pressures in the mines to the pressure recorded by the water levels in that well.

Over here on the right panel is Exhibit No. 5, No. B-5, and this is the map for the west mine. And this also is a structure contour map, superimposed on mine workings, prepared in the same way. This was the mine that was closed in 1950. And you see the lines of equal elevations structurally here, and the dip, and now the interval is 20 feet. So you see 20 foot drops between the lines down to the south. And here again, there's no indication of faulting on this map.

And I conclude that, from these two excellent mine maps, recording structural elevations on coal seams, with no faulting, that, in fact, the main part of this cavern, that is where the mining occurred, is not broken by natural faults; therefore, there could not be leakage to the surface by natural faults as people have proposed.

Q All right. Dr. Weimer, if we could now move on to the second part of your report, Cretaceous stratigraphy. Could you explain to the Commission what you mean by that term and how it applies to the geology relative to the Leyden Facility?

A Well, the term, "Cretaceous," is referring to a period of geologic time. And it's the interval of time from 135 million years to 65 million years ago. The geologic formations here at the Leyden Facility are four in number, and have an approximate age of 68 to 66 million years. This stratigraphy, the definition is study of stratified or layered rocks and sedimentary rocks. And here the stratigraphy would relate to the different formations present and their distribution and origin. And that's the general definition of the term, "Cretaceous stratigraphy."

Q Have you prepared, in your exhibits, any exhibits to assist you in discussing the Cretaceous stratigraphy?

A Well, I have, and I can turn to the Exhibit No --

Q B-6, I believe.

A Exhibit B-6, which is a structural

section, stratigraphic section. And it shows the electric log cross section on this B-6. Here's a well at the north edge of the area, which would be up in this region, the Public Service 2 well to Public Service No. 12. It's the well which Bill Uding said they pumped water out of. And then there's a well about three miles to the south, off the index map, shown on this stratigraphic E log section. The four formations present in this area. The Pierre Shale on the top is exposed, and in, generally, in the wells. It's actually 7500 feet thick. So it's a very thick shale formation.

Above that is the Fox Hills sandstones, from 50 to 70 feet thick. And that's 800 to 1000 feet of the Laramie Formation before reaching the youngest contemporaneous unit, the Arapahoe. The Laramie is divided into a Lower Laramie and Upper. And the Lower Laramie is the interval -- the lower 300 feet is the interval where the coals were mined and where the gas was injected. The Upper Laramie is like 600 to 700 feet thick, and contains largely the claystones that form to seal over the top of the mined area where gas is injected.

The starting point for studying, for me, to study stratigraphic units is looking at the outcrops. This is Exhibit No. 7, and it shows the exposures of the rock layers on the Leyden Ridge, remember, on that structural section I showed you, that turned in upwards and were dipping very steeply.

This diagram has,along the left side, what we call a, "stratigraphic column." It's a plot on a scale here of 0 to 100, 200, 300, a plot of the different layers that are exposed here on the north side of Leyden Road in the Leyden Gulch, where it cuts the Leyden Ridge. The Fox Hills and Laramie Formation are exposed a little over 300 feet.

And you'll notice, by the symbols here, we show a lot of the shale units with very thin sands and coals. And the middle part of the section, there's a sandstone unit that's about 50 feet thick, which forms the main resistant ridge in the Leyden Ridge. Then, the upper part of the section here, shown on the south side of Leyden Gulch, is back to thin coals, sandstones, shales. A little bit of Upper Laramie is exposed. That's 250 feet of the Lower Laramie.

And it's possible to divide this Lower Laramie into three intervals. The lowest interval, or the thin coals and siltstones, about 70 feet thick, I call, "Interval 1." And on the lower part there of the picture, you see where Interval 1 would fall. Interval

2 is sand and claystone and coal. That is the interval between the A and B coals. Those are two coals that were mined in the subsurface. And above that, then, Interval 3, which, in this log, has thick sands in the lower part and then back to coal shales and sandstones in the upper part. The intervals which are shown here can be traced into the subsurface.

And this is a log of Well No. 36, which has been mentioned before. It's the well that was an observation well drilled here, just south of the east cavern, which is Mines 1 and 2, drilled 375 feet south of the section line, which was the south boundary of where they mined, the lease boundary.

This is an -- I think I mentioned that this was Exhibit No. 8, but it's a log of Public Service Company Well No. 36, and it shows Pierre Shale, the top of it, Fox Hills sandstone -- each of these divisions here would be 10 feet, and the log is from 700 feet depth down to about a little over 1200 feet, about 500 feet a section.

This shows a gamma ray curve on the left with a self-potential curve and index curve on the right. And from these curves, plus other logs that were run, the density logs and neutron logs, it's very easy to pick the coals, the sandstones and shale layers. And I've shown here, on the right side of the log, the coal layers shown by the black. And you'll notice that the B coal is here, about 70 feet above the Fox Hills sandstone. Then 60 feet or so to the A coal, which is up here. And then on up to the top of the Lower Laramie.

The overall lithology is claystone or shale, with thin sands, generally 12 feet or less in thickness, and coals, which are up to 7 or 8 feet in thickness. This is the mined coal here. To the north of this 375 feet is where the coal mine collapsed after mining. This well was drilled where no mining occurred. And so we have a complete record in the logs. And here -- marked on here is where the collapse zone would be, which is estimated by the Expert Sherman as being something like 60 feet. He will discuss that in more detail. And above that collapsed zone, there would be tensional fractures that would extend another distance up into the overlaying rock. This is thought to be like 40 feet.

How we know that, because storage gas has been identified in that sandstone, where it says "Gas in Sandstone," and that gas would have migrated into that sandstone, where there was overstorage of the cavern, and then migrated laterally, where it was trapped in the sandstone lens. And I'll talk more about geographic distribution of these types of sandstones that has occurred here in the Lower Laramie. I think, a lot of them, where they have crossed, have a geographic distribution of only 3 to 5 acres. Keep that in mind, because I am going to develop that case as we go along.

Now, this is one type of sandstone that's present, thin, lenticular, and interbedded, intimate with the coal beds. That's the second type of sandstone present, which is thicker and much more massive. This sandstone is shown on Exhibit No. B-9, and it illustrates different types of logs. That is gamma ray on the left, from which we read, incidentally, lithology, whether it's shale, siltstone or coal or sandstone. And on the right of this exhibit is the mud log, which indicates drilling rates. Lithologic log, that's composition of layers. And a gas induction log -- I'm sorry -- a gas detection log. That's mislabeled, and, incidentally, it should be gas detection. And then lithologic descriptions on the right.

Here again, the exhibit is to show you the nature of a second type of sandstone that occurs here in this area. And it's what I call, "the channel sandstones." You'll notice the gamma ray shows 24 or 25 feet of massive sand just above the B coal. And up here, 45 feet of massive sand above that. I've labeled those, "Interval 3a" and "Interval 3b." These are point bar type of channel sandstones that occur in major channel systems. They occur north of the Leyden facility, and in four or five wells that have been drilled here in Section 22, generally the north half. And they're the sandstone that I showed you in the outcrop trends up here and across this region. So we have a chance to see some of these sands in the outcrop. Now we see them in the wells.

One of these wells was cored, not this one but a nearby well. And it showed that this lower channel sands had excellent reservoir characteristics. It had 21 to 25 percent porosity and 500 to 1500 millidarcies permeability. That's in contrast to the thinner type of sandstones that occur here in this Well 36, where the porosity and permeability of these thin sands generally, where they have been cored, is on the order of 8 to 12 percent, with maybe less than a 10th of a millidarcy permeability and -- but every once in a while you get a good porosity and permeability, as shown in that gas sand, and we have to explain why, in some places these sands are so tight and other places you'll see porosity and permeability. That's part of the story I'll develop for you.

So, this gives, then, some idea of the stratigraphy of the distribution types of lithologies, and also gives you an idea of the porosity and permeability that occurs in different types of sand bodies.

Q All right, then, Dr. Weimer. Let's move on to the third portion of your report, which relates to reservoir and seals for gas, again, relative to closure of the Leyden Facility. And the issue in this case is whether sandstones above and below the mine rubble zones are continuous and sheet-like on the one hand, or whether they occur as lenticular and isolated lenses on the other hand, encased by impermeable claystones that form seals to prevent gas migration. First, what is your conclusion?

A Well, my conclusions are that these sandstones, all of them that I described for you, these two types are very lenticular. I mention that some of these thin sands have geographic distributions of porosity and permeability of 3 to 5 acres, whereas these point bar sands might be on the order of 10 to 20 acres. And you know about these point bar fluvial sands because you've been issuing spacing regulations to downsize at the 20 to 10 acres in some cases. These fall into that category of the type of fluvial sands you see in the gas fields of Western Colorado or Southwestern Wyoming and so on.

I want to show two exhibits, though, that answer your question as to the distribution of these sandstones that would be a part of the collapsed rubble zone, either below or above. And I'm going to show you first the Exhibit No. B-10. And, again, this is a map of the outline of the Leyden project area. This is an isopach map on B-10 of the thickness of Interval 2. Remember that was the interval between the A and B coal zones. So, in different parts of the mine, this is the interval that might get influenced by the rubble zone, or the sandstones, and the interval that might be -- have pathways that would introduce gas into these sandstones.

And the first map, this one shows the thickness of the interval, A to B coal, and this shows that the thickness varies from 20 feet here, over in the west mined area, to 70 feet over in the east mined area. And that minimum thickness is about 20 feet. The maximum is about 70. That's just the interval. I'm not talking about what the composition is, although I can tell you most of the composition is claystone and siltstone. Less than 40 percent is actually sandstone. But here you see the source of the sediment brought into this area shown by the contouring thick to thin, is from the south. And that would be a major channel system there where these sediments were carried from that channel river system out here into what we call the "channel margin area."

Up here at the north end of the facility, there's some thickening that suggests there's another channel system to the north. And, incidentally, that's the edge of that meander belt system, which is outside of the area of the mine, but it's younger, is not of this age. Here you see a percent sand within this thickness varying from 20 to 70 feet. In that central part, where the interval is very thin, you see there's no sand at all. It's zero.

Q Which exhibit is that, Dr. Weimer?

A Thank you. I am sorry. Thank you. It's Exhibit 11, B-11. Thank you. And here then you see that sand increases in thickness in the interval from 0 to a maximum of about 40 feet. That's not one solid sand. That's three sand levels lumped together.

To give you some idea of the thickness of the sand, remember sands in these intervals are 10 to 12 feet thick generally. Over here, you see some source of sand from the north side. And of particular note here is the fact that these sands, although it would appear that the yellow -- the way the sediment was carried down a channel is continuous, the sand within that channel is quite lenticular. And I would show you that with some later diagrams and convince you that, in fact, they are not continuous sandstones. And so you can see from the log exhibits I showed you, plus taking this as an example of sands, that you do not have widespread sands, so that, if gas got into one of these sands, it would spread all over and get away from the area of the facility, the Leyden Facility. I don't think that happened.

Q All right. And turning our attention to the seals. What are the seals in the Laramie Formation that prevent migration of gas from the storage chamber?

A Well, the Upper Laramie Formation is a seal. And that's because it's largely claystone. And I have here, on Exhibit B-12, again, a geophysical log with the gamma ray here on the left, with an SP, and, in this case, an index log on the right. I selected this well to talk about seals because the well was cored from 610 feet to total depth, which was over 1100 feet. And the Upper Laramie was cored through about a 100-foot interval. And one of those cores was selected for lab tests to indicate porosity and permeability and entry pressures and so on.

But, let me point out, while I have this here, there are a few thin sandstones in the Upper Laramie regarded as sealed rock, but they are generally five feet or less in thickness. And there are, undoubtedly, some sealing beds, like a zone through here of plastic claystones, that would be a better seal than what I'm going to describe for you on this sample at depth 649, an area like that, an area like that, so on. So the logs can help us identify some of these other sealing beds.

Before I discuss that sample, if you go back to those mine maps, the mining stopped where there was still coal, so the lateral seals are actually coal beds. And this will be, I think, some aspect of this will be discussed by Dave Cox when he talks about coalbed methane and gas and so on. But, I think most people would recognize those coals as sealing beds across the top seal. It's these types of claystone beds shown by logs and cores. And the floor of the mine, the coal was cut out to a floor which was largely mudstone or shale. So the bottom of mine is also a claystone seal.

So, that would cover the main sealing

aspects. And let me get into the exhibits, then, that would show what the thickness of this Upper Laramie seal is over the cavern, the rubble zone of the cavern. And then let me show you the results of the laboratory tests trying to determine the quality of the seal in the Laramie Formation.

This diagram on the left is from Barrows in their report to Public Service in '97, and he answered the question, how thick is this Upper Laramie Formation over the Lower Laramie where the injection of gas occurred. The depositional thickness of the Upper Laramie is on the order of 750 feet, shown by these contours on Exhibit B-13. But because the Upper Laramie is eroded into by present day stream cutting, that's been thinned to less than 500 feet, just under 500, and in this region of Barbara Gulch to the north and to the area of the Leyden town site. However, 500 feet is more than adequate amount of these claystones to trap all of the gas, and much more, in fact, if it were placed in there.

This Exhibit B-14 shows the results of taking this shale sample, at 649 feet, and taking it in the lab, where they have a high pressure chamber, and then injecting mercury into that sample to determine the entry pressures of the claystone. First let me --

or shale.

It's only been in the last 15 or 20 years that the equipment to do this type of analysis on shales has been developed. So that -- because it takes equipment that would have 55,000 pounds capability of psi pressures. The shale sample -- they call it, "shale," it could be called, "claystone," a term that's interchangeable -- it had a permeability, the Klinkenberg permeability of .042. Porosity was something like 18.6 percent.

The claystone layers are composed of individual particles of clay that are very small, 1/256th of a millimeter. The clay layer, the clays will stack one on top of another, so there's still porosity there. But the pore throats are so small, you don't get any movement of fluids through them. So they become very good seals.

And all this table at the top here is is recording different injection pressures, that left column, and the rest, then, is recording interpretations of those pressures. I think this data is plotted really on this lower left curve, which is called a "mercury injection curve." And over here, on the left side of the curve, you see injection pressures and psias from 0 to 80,000 pounds. And across here you see the percent of pore space occupied by mercury, 1/10th of a 1 or 10 percent to 30, 40. You notice how much pressure they had to put on that sample in order to get the mercury to inject into the pore throat. So -- and that the conventional thing is to look at 10 percent injection, but that's over 1,000 pounds per pressure, entry pressure. Very high. Over here, you just are plotting information that shows the pore diameter of the pore throat, and so on.

So this type of data, I won't go into any other detail on it, but it's conventionally used now to determine how good the quality of the seal is. And let me say that if you were to run these on all kinds of the claystones out there, you would find similar results. They are good seals. And that would be true not only in the Upper Laramie, which is the top seal, but also be true of the claystones which are surrounding the lenticular sandstones. So, gas got in there. It would be trapped within those small, discrete lenses. So, that's a quick rundown on seals.

Q Thank you. Finally, Dr. Weimer, very important question. Will taking the storage gas out of the storage facility have the effect of reducing risk of migration of gas?

A Yes, it will. Because the gas migrates from higher pressure to lower pressure areas, especially when the pressure exceeds the hydrostatic pressure of water. So, as the pressure is reduced, where will the gas migrate? It's going to reverse the flow and go back into the chamber that's been described as the rubble zone. And, so, the risk of the gas, if it spread out in -- upwards into sandstones, that's going to drain back, pressurewise, back into the rubble zone.

Q All right. And before we turn to the stratigraphic model for integration and prediction, which was the last portion of your report, I have a question, which we've been asked to specifically address. This is probably the appropriate time. Could you address the possibility that gas, in its natural state, in other words, nonstorage gas, underlies the area surrounding the Leyden Facility?

A Yes, sir. I would like to do that. In 1982, Teton Energy Company drilled the 22-1 well, which is shown here on the top of your index map. That's the No. 1. It's called the Church 22-1 well on that Exhibit 1. I have no exhibit to show this well in relationship to the Wattenberg Gas Field, but let me say that this well was 3600 feet north of the Leyden Mine. That it found gas accumulation at a depth of

9508 to 9556. That a production test for 24 hours flowed 326,000 cubic feet per day, with 10 barrels of condensates, per day, and 675 barrels of water. That flow was through a 32/64 inch choke, with a gas/oil ratio of 33,600, and bottom hole temperatures of 226.

Now, I've done a lot of work on the Wattenberg Gas Field to the north of this. And when I see plotted this on a map relative to this south boundary of this Basin Center Gas Field, it's only six miles away. And so, there's an, in my judgement, the producing formation in this Teton well is the same "J" sandstone as is producing at Wattenberg. That the edge of the Wattenberg Gas Field is only six miles north of the Teton well. The Wattenberg/Basin Center accumulation may very well extend to the Teton well, and to the Leyden Facility and farther to the south. That's the nature of this big accumulation at Wattenberg.

The Upper Laramie seal for gas storage at the Leyden Facility traps the gas at 700 feet to 1,000 feet. That would also be a vertical seal for any gas migrating from this 9500 foot level. However, if there were a breakage, which I say there is not, due to faulting, you would have a great deal of difficulty telling the difference between gas from the 500 feet and natural gas relative to gas put in the storage that might leak to the surface. So, the main point here being that gas did occur naturally, at depth, as it occurs in the Denver Basin. And there is an accumulation of that gas north of the mined facility. And people that are using surface soil gas analyses should be aware of such an accumulation as it relates to how they interpret data and so on.

Q All right, Dr. Weimer, finally turning to the last part of your report, the stratigraphic model for integration and prediction. First of all, why is stratigraphic modeling important with reference to closure of the Leyden Facility?

A Well, stratigraphic modeling is the integration of all geologic data that relates to the origin and distribution of stratigraphic rock layers. And each layer is explained by reconstructing the sedimentary processes in the environmental deposition. So, it's a way you can combine everything together, and hopefully, I've got my diagrams to help explain some of these figures that I've used for you, of the size and distribution of the reservoir sands within this region.

I'm going to show you an exhibit which is Exhibit B-15. It shows a 2002 lithologic description of different types of sand bodies, the different sizes and so on. And it interprets, then, how these layers were deposited, in which environments. So we have lithologic descriptions of stratification, the layering, cross-layering and fossils that are contained.

Let me first say that the fossils indicate that all of the Laramie Formation is essentially fresh water formation coals, being the biggest indicator coals are from fresh water swamps. And then within that, then, you see the layers interbedded with coals, and you have to interpret what they are. And the lower left shows a cross section of environments taken from modern deposition environments, like the Mississippi River. Shows major channels, levees, back levee swamps, and lakes or bays. Those, as areas subsided, then, of course, layers accumulate in different environments of deposition.

On the right you see what's called a "crevasse splay." That's where, during the flood stage, the waters break through the levee and sediment splays out during floods, like you see pictures of all rivers, onto the floodplain, and these are called, "crevasse splay deltas." Within those systems, you find these water course ways, which could be called channels, crevasse splay channels. And there are Delta front type of sands on the front end where they build into the shallow bay, and then the channel sands. The only reservoirs that I see in these channel margin areas are the crevasse splay channels. And I would describe those for you in a little bit.

If you take that information and relate it, then, to a study of the formations, shown by this Exhibit B-16, which is a three-dimensional diagram, with a front panel here of the rocks found in the Lower Laramie from south of Golden to Rocky Flats, that's a distance of about 10 miles or so. And I've alluded previously -- well, let me first show you that section of the Leyden Mine as shown by that square.

So, we see here the summaries of what I've shown you on logs or other exhibits. You see a, for example, the Fox Hills sandstone at the base. You see the Lower Laramie Interval 1, Interval 2, Interval 3. Remember Interval 2 is between the A and B coal seams. The A and B coal zones are shown there. They would pinch out to the south. The source of sediment for what you see in that interval comes from channels in the south area. That's a diagram of three of these fluvial channel systems, 1, 2, 3. And note, then, that there are tongues of sand that extend out into the coal basin between two of these major fluvial systems. So the lower part of Interval 3 would be the channel sands that I showed you in the Coal No. 3. And this shows three of those levels, labeled, "3a, 3b and 3c. 3a and 3b was on the E log. And these shaded areas within that are the clay plugs that form when the channel abandons. It becomes a lake and fills with this permeable clay and that's what breaks these reservoirs -- point bar reservoirs up into these small diameter sizes of 10 to 20 acres.

Now, most important to what we are talking about here are these splay channel systems on the splayed deltas. And here's a model that was first put together by a study of modern systems by Shell Development Company on the Gulf Coast. And the exhibit is B-17. And it shows a map view here at the top where there's a narrow channel. And these splay systems are 250 feet wide, levees on the margin. But water that flows down this straight channel as a sinuous path, so sandstone that's being transported on the floor of the channel gets stacked up in what's called, "lateral bars." They are like little miniature point bars along the edge of the channel systems. And that would be the flow of water. I call these "lateral bars." They are colored here in brown.

If you look at a longitudinal section

down the channel, you see that they come up to the thickest, and thin come up to thicker. So they are lenticular. As you go down the channel, you'll find areas of discrete, isolated sandbars. Here is a cross section. B-B' shows how, over here on the side of the channel, you see the lateral bar. What happens when this abandons, well, you see it becomes a lake. And flood waters carrying silt and clay flow into that lake and fill it. And now you have impermeable beds, sealing beds, which seal these individual little sandbars.

What about the dimensions of these bars? Well, I mentioned that I've diagramed here a width of the channel of 250 feet. It might be 300, maybe less. And the sandbars then would have a width of like 200 feet. And a length, in this case, of this bar, I put there 1,000 feet. This one up here, I put 600 feet. 500 feet. How big is an acre? It's 200 by 100 feet. So, if you've got one of these sandbars, that's 200 feet wide and 1,000 feet long. Covers five acres. If it's 600 feet long, it covers three acres. So, if you want to know where I got the figures of three to five acres, for the size of these porous and permeable sands, that's where it comes from, where you get into this type of system.

I'm going to wrap this up by talking about a concept that we have in geology, that the present is the key to the past. When we look at ancient rocks, we can see the end result of processes, but we don't know for certain what those processes are. We can reconstruct them as best we can by a whole variety of methods, but one of the ways that's been used is to go and look at similar type of deposits, in this case, fluvial deposits associated with the river systems, and do measurements to see what the processes are that forms a point bar.

So, if you turn to Exhibit B-18, what you see here is a, first, on the upper left, an index map, that shows the river known as the Brazos River. Flows just east of Houston, Texas -- west of Houston, Texas. And it's 50 miles from the Gulf of Mexico, which is at the bottom of the diagram. The study area indicated was the region selected by Shell Development Company, who had research labs in Houston. And they come out here and do work on what's called the Oyster Creek Meander Belt. That's an old meander belt on the east side of the Brazos alluvial river valley, which is about 10 miles wide. And on the upper right diagram, here, you see a index map of three traverses of core holes that they placed in this mile and a half wide meander belt, which is composed of lots of individual little point bars sandstones. And you see the old meander courses there that have been abandoned. Now they are lakes.

They had three traverses that they placed about 1,000 feet apart. And each of the drill holes in those traverses were 600 to 1000 feet spacing. They were trying to get at something that would relate to 40-acre spacing, which is commonly used in oil fields. They ran logs of -- self-potential logs within those drill holes. From those logs, you could also select sand thicknesses.

Now we'll look at a detailed overcontour map made from the well logs, and the thicknesses of sands within this Oyster Creek meander belt --

Q What exhibit is that, Dr. Weimer?

A Pardon me?

Q What exhibit is that?

A It's B-18. And what you see is the --

Q Would you check that again? I think it might be 19.

A Oh, it is 19. Thank you. Thank you. Now, where the water -- old water courses were, the channels got abandoned as lakes. They couldn't get sandstone samples. They did grab samples. Determined, in fact, that there were zero sands, or nonreservoir sands within those meanders. So each of these bar sands tends to be encased by these clay plugs. And if you look at the dimensions, the scale here of zero to 1 mile, if you look at these, there would be 1 square mile there would give you about 16 of these bars, so that you end up with these bars about 40 acres in size.

Okay. Well, this river is larger than the Laramie rivers. Here, the depth of the channels are 60 feet. The overall flow of the river is thought to be larger. So -- and the Laramie point bar system, like that northern area that I described, north of -- that's where I come up with the 10 to 20 acre size for those particular point bars systems. So, you can see how processes from modern systems can be adjusted back in terms of size of river systems to get at the dimensions of the rivers and the point bars and sandstones, as it relates to reservoir in the Laramie.

And I've given you, then, another exhibit here, which would be B-20. This is a small river. You know, we can look at different sizes. If I went to the Mississippi, point bars there, in that big river, would be one square mile. Well, this is a river called the Guadalupe River, which is in the central Texas coast. This is the index map, shows that it empties into the

San Antonio Bay. It's not a large enough river to even build-out to the gulf, which is shown here at the south margin of the diagram. And at the bottom of this diagram, there's some indication of the different aspects of this Guadalupe River within this overall delta. For example, it builds out into a bay that's about 10 feet deep. That's kind of critical, because that controls the thickness of the channel sands. What is the depth of the water into which they build? The width of the channel systems are on the order of 600 to 250 feet, so on.

Exhibit B-21, then, shows that overall delta, but it shows the crevasse splay subdeltas that build out away from the main water course and these are one to two square miles in size. They are the size, really, of kind of the Leyden area, where we're looking at a couple of square miles and trying to understand the distribution of sands and claystones and you'll notice on there the water course ways. Those would be the channels that come away from the main Guadalupe River itself.

And here is a cross section that shows all of the different types of lithologies described -- found in this Guadalupe delta as described by Donaldson in 1970. And you'll see a widespread delta front sand underneath the channel; that that would be tight sandstone. That can explain why sometimes you see these Laramie sands that are tight, low porosity and permitability.

What's the best and only reservoir? It's that channel, remember, that's the 100 to 250 feet wide. So, you get some idea here of the dimensions that I've used, relative to the modeling for these different type of sandstones. And I'll just summarize that by saying that you actually can go to modern systems, you can observe the processes. You can bring them back and apply them to interpreting sandstone morphology and reservoirs within this area of the Leyden Facility. And when you get through, you end up with these little channels, like shown on this last exhibit, having these bars of three to five acres within them as reservoirs, isolated by claystones. And you see the point bar systems, which I've adjusted to 10 to 20 acres in that system to the north.

The only reason I put that in is to show you the model of both types of sandstones. Not that the channel sands up there, the point bars enter into this discussion of the sandstones in the mined area, because they don't have those types of sands. There are not those types of sands in the mined area themselves. I might add, though, that those sands to the north, all of the log detection -- gas detection logs run in those four or five wells that have those sands do not show any gas in those sands. So, it does not appear there's any leakage of gas to the north in that area.

Q Final question, Dr. Weimer. In your expert opinion, will the plan proposed by Public Service Company protect public health, safety and welfare and protect the environment?

A Yes. I believe this plan is well-conceived, and it can be implemented to achieve the stated objectives.

MR. KEEFE: Thank you. Those end my initial questions of Dr. Weimer, and I would request that Exhibits B-1 through B-21 be accepted into evidence.

CHAIRMAN MUELLER: Yes.

MR. KEEFE: We would tender Dr. Weimer to you for any questions which you might have.

CHAIRMAN MUELLER: I think we do have a few questions. We also have had a request for a short break. So, if we could take 10 minutes and then come back.

THE WITNESS: I would like that.

(Recess.)

CHAIRMAN MUELLER: Okay. We're back on record. And again we would like to start with Commissioner Reagan. Questions for Dr. Weimer.

EXAMINATION

BY COMMISSIONER REAGAN:

Q First of all, Dr. Weimer, I want to thank you for giving me four years of geology in about an hour. It's very helpful to understand the structure and stratigraphy of the area around Leyden Mine. I have a couple of questions and would like to reinforce the record on a couple of points.

If we could go to Exhibit B-2. Okay. That exhibit shows the two coal seams, A and B, and they're shown to be relatively flat, with a very modest dip, which was also indicated in your structural contour map, which was the following exhibit. But in B-2, if you look to the far left there, about 600 feet beyond the west edge of the actual Leyden Mine.

A Yes.

Q You show a couple of faults in there.

A Yes. Right here.

Q Yes. Those two right there.

A Right.

Q Were -- those faults have gone to the

surface.

A Yes.

Q Okay.

A Well, this one -- there are two -- there are two style faults here. One is a fault that is shown nearly vertical, and that was drawn, based on the thinner sections in the outcrop compared to the mined area, the 250 feet of Lower Laramie here and 350 feet there. And so, the fault was drawn to explain thickness variation. And it was -- oh, I think I first probably published that in 1973.

They now have a seismic line shot two and a half miles to the north in the area of the Rocky Flats nuclear plant. And that line shows strong evidence for a reverse fault, as shown here. That explains why these tightly dipping beds change so abruptly in the coal zone, but this is would be what you call a, "syndepositional fault." That was active when the sediment layers were deposited. This is what we call a "Laramie fault." That would have formed, say, 55 million years ago. It's younger.

Q The point of my question was simply to reinforce the fact that if there had been any faulting within the area of the Leyden Mine or the mine cavern, you would have seen it reflected in a couple of different ways. You would have seen it reflected in your structure map, because you would have had dislocations that would have be very apparent.

A Right.

Q Okay. And where you did have faulting, to the west of the mine, I guess, it is reflected in the steeply upturned beds?

A Right.

Q And then the other point, to make sure, is that at least on the scale of this cross section, it would have to be 600 feet or more from where the mining operation stopped before there was any indication of a fault?

A Yes.

Q So, there are no visible connections from the mine cavity to the surface?

A That's correct.

Q Okay. Then if we could go to, I think it's 10c. This is the permeability curve, pressure curve.

A All right.

Q That's it.

A The mercury injection curve.

Q Mercury injection curve.

A Okay.

Q I think the important point there is the fact that, in terms of transmissibility, or permeability, there is none.

A Right.

Q Virtually.

A Yeah.

Q The maximum pressure in the mine, I believe, never got above 300 pounds.

A That's correct.

Q And if you look at the curve on the left, you would see that you have to get well above the 1,000 pounds before you get any penetration at all. I mean, that's nothing. That's -- I don't know how to translate that into millidarcies, but it's about like nothing.

A Yeah, right.

Q So, here again, there's no permeability through which gas could move at the pressures we're talking about in the mine.

A That's correct, yes.

Q Okay.

A And I thought this laboratory data would be a good confirmation of just the general statement that the Laramie -- Upper Laramie is a seal. When you get data like this, you can confirm that very clearly.

Q So, that then you could conclude that the only way that there could have been any communication were manmade holes that might have leaked but subsequently were plugged.

A Yes. And there's a record of that.

Q Yes.

A That will be covered by Dave Cox in the next testimony.

Q Okay.

COMMISSIONER REAGAN: I have no other questions.

EXAMINATION

BY COMMISSIONER SHOOK:

Q I guess you talked about the fact that the mining was done by the room and pillar method.

A Yes.

Q And, typically, how wide or how large are the rooms that are actually left?

A Well, I would like Greg Sherman, who is an expert on the mining -- he'll testify later -- to answer that. But the haulage ways are generally a couple hundred feet wide, and, of course, they get smaller as you go back into the mined area themselves. So I think that -- and sometimes the pillars that are left are wider in some part of the mine and narrower in others. If you study those mine maps, you'll see this variation and range might be from 100 to a few 100 feet in terms of the pillars that are left, and in the mined area, maybe 100, or something like that.

Q I guess my questions probably should be directed to him rather than you.

A I think so, if you wouldn't mind, because he is prepared to do that.

Q I guess I have no other questions.

A As it relates to the collapse and rubble, so you'll find that interesting.

Q I was interested in the collapse and rubble.

A He'll cover that.

COMMISSIONER SHOOK: Okay.

EXAMINATION

BY COMMISSIONER CREE:

Q Actually, I just have one question. It goes back to the concept of this unaccounted for gas. Those 3 BCF.

A Yes.

Q You told us a lot about the caps and seals and that. Any explanation, from a geologic standpoint, of where that gas might have went, and, you know, could it have migrated out horizontally, and captured just a couple of small areas down there, that it is still capped and sealed?

A Um, I think the most likely place that some of it has gone -- first, you don't know for sure how far this was, but the most likely explanation is some of it has leaked into the -- from the rubble zone into sandstones that would have had fracture contact with that when the rubble collapsed occurred. And that would be those thin sands that I showed in the A to B coal zone. And, in fact, there's an example of that in Well No. 36, because that gas has gone 100 feet above the A coal zone, roughly 90 to 100 feet, and then went into one of these lenticular sandstones. And Dave Cox will talk about production tests from that sandstone as to what that production test tells you about the size of the reservoir.

And, so, as this case develops, you'll find that there's a lot of details that fall into this framework that I've given you. And I have borrowed on some of those, and some of the work I did before I had that information. And it kind of confirmed it. So I think that there is no doubt that there will be some gas in these sandstones that have tensional fracture connection with the rubble zone. How many? I think Dave Cox estimated there might be as many as 10. I think he maybe will use that in his testimony.

Q So he then may quantify how much gas?

A I think so. He'll answer that question for you more fully.

Q And, final question. Say that gas is there. Is there any risk to anyone of that gas, since it's still going to be sealed and not capable of migrating to the surface?

A I don't think -- I mean, the risk is very minimum because -- and in those particular sandstones. If there is a connection with the storage gas chamber, it's because of the collapse and some of these tensional fractures that extend for 40, 50 feet vertically. And when it hits these plastic type claystones, and it hits the seal, and without -- the reason I developed the case of no natural faulting was to point out that it's only these manmade fracture systems, close to the collapse zone, that might permit gas to go into these sandstones, within 100 feet or less. And also, then, they -- it hits the Upper Laramie. It can't go any further. That's it.

And as far as going horizontally, I think the coal was -- that are described in these mines happens where the mining stopped, and that the coal then becomes the seal on margins, yeah.

EXAMINATION

BY CHAIRMAN MUELLER:

Q Dr. Weimer, my experience with seismic data, while I don't profess to be an expert in its use, has been more on a relative basis than an absolute basis. In this situation, where we're looking at some relatively shallow formations, do you have a sense as to what the resolution of seismic data would be at these depths? In other words, could you predict some relatively small fault in using seismic?

A Um, well -- of course it depends upon the system completely. And the seismic lines, the first ones that I talked about, were in 1992. And I don't have the information with me. My general feeling, to answer your question, is that information is about details of the system that was operating. But my general feeling, in looking at that data, was that you would probably see a dislocation that might be -- and breaking up of the seismic reflection that would be 10 to maybe as much as 20 feet.

Now, if you consider that rubble zone might be 40 or 50 feet, and then you're shooting and you're getting good reflections from that general coal area, and all of a sudden you hit an area in which your reflections deteriorate, that's what I call the, "dislocation."

Q Uh-hum.

A Then they are showing 10 to 20 milliseconds offset there, which would be 10 to 20 feet. I don't know if the resolution would be quite that good. I would say that's probably okay. 10 to 20 feet.

Q Okay. Thank you.

A Uh-hum.

Q Also, in this area, where the coal has not been mined, would you expect to find methane trapped in the coal that still exists?

A We've discussed this at length as to how much penetration that the gas under that pressure would -- how much distance it would go back into the coal. And I think David Cox will discuss this in the next testimony, but it's not very far. And maybe you can pin him down as to what he thinks that distance is, since he's been doing the work on coalbed methane.

Q Okay.

A Okay. It's in the order of feet, you know, or something like that, rather than 100s of feet, or anything that would ever take you outside the burn zone away from the mine, for example. That just would not happen.

Q Okay.

CHAIRMAN MUELLER: Thank you very much.

EXAMINATION

BY COMMISSIONER KLISH:

Q I have just one question on Exhibit B-4.

A B-4. Let me get it.

Q The relationship to the seismic line, GR-5. You mentioned it -- I think I recall that you said that they had done some soil gas work along with this, and they found some detection along that --

A The soil gas analyses were made in -- the shot holes for this line, I think, were six feet and loaded with some black powder and then shot. So when they drilled those boreholes, they also did some soil analysis work at the same time.

Q And they had some positive detects in those too you said, or not?

A There are some soil gas anomalies. These are going to be discussed by David Folkes in his testimony, which is about that particular subject. And he'll review that in great detail with you and show you some of that data.

Q Thank you.

EXAMINATION

BY COMMISSIONER CASEY:

Q I have a question about the drill holes and when they were being logged. For example, on your exhibit that shows the log of the drill hole No. 36.

A Drill hole 36. Okay.

Q When was that log run? What was the date?

A The date of the well.

Q How did that work? Did they log the wells right after they drilled the wells or --

A You know, I don't -- I can't answer that question. But this well is going to be discussed by Dave Cox, and that -- and the gas sand. And he'll use some neutron density logs to show a gas effect relative to that sand. And so I can't answer the question.

Q Well, did you have logs available for all of the drill holes?

A What?

Q Did you have logs available for all of the drill holes that you could use today?

A The last group of drill holes, starting with Well 31 through 36, plus test holes 1, 2 and 3, there is excellent log suites. The gamma rays, self-potential, induction and neutron density logs, and so on. And most of those have mud logs on them with drill-time logs as well as gas detection logs.

Q So, did you use -- did you utilize that data to make cross sections in your stratigraphic study?
A Cross sections?
Q Well, did you use the data available from the logs?
A Oh, yes, yes.
Q And that fits in well with the old maps?
A Well --
Q Or --
A Let me tell you what I generally used and grade the information relative to this study. The mine maps, in my judgement, are the very best geologic information because they are continuous data, over a large area. 200 -- two miles north -- east-west and two miles north-south. Then I used the outcrops to tie into these intervals in the Lower Laramie with the coals. And then I used, next, all of the wells that had been cored, and there are about five or six wells that had cored the interval that had good porosity and permeability determinations. And then I used the logs themselves to -- geophysical logs to make as much of a lithologic determination as I could. And then I reviewed all of the data that people had put together relative to those, and eventually got around to doing

what I've done here.

Q I sound sort of crazy. I guess I was wondering if the gas effect in the log was gas that was in the mine before they started to inject or were those logs run after they injected the gas into the mine?

A Well, I'm not sure I can answer that question with great certainty. But, generally speaking, the grade of coal in this mine had very low methane in the coals. And, so, David will discuss this briefly, but it was not a gaseous mine.

Q It wasn't gassy.

A And so they don't have good thermal information, but the grade of coal suggests that it's subbituminous, very high volatile type of coals, somewhere around 9,000 to 9500 BTUs per pound, which is pretty low grade coal. Well, it's good coal but it was not gaseous.

COMMISSIONER CASEY: Thank you very much.

THE WITNESS: Yeah.

CHAIRMAN MUELLER: Any other questions?

COMMISSIONER REAGAN: No.

CHAIRMAN MUELLER: Thank you very much.

THE WITNESS: Yeah.

MR. KEEFE: We're going to take just a second to redo exhibits here, please.

Ready to go, Mr. Chairman?

CHAIRMAN MUELLER: I think we are.

MR. KEEFE: All right. We would like to call as our next witness, Mr. Dave Cox.

EXAMINATION

BY MR. KEEFE:

Q Would you please state your name and address for the record.

A My name is David O. Cox. My address is -- business address is 1010 10th Street, in Golden, Colorado.

Q And Mr. Cox, I'll refer you to the last section of the exhibit book in which there is a transcript that is your resume. And I would ask you to -- was this resume prepared by you?

A Yes, it was.

Q All right. And for the benefit of those present, who may not have seen your resume, I would ask you to highlight just a few of your qualification as a petroleum engineer.

A I earned a bachelor's in petroleum engineering from the Colorado School of Mines in 1974; master's of petroleum here in 1977. In 1975, I began working full time in the industry for a small consulting firm called, "Energy Consulting Associates."

I worked for them for about six years. And I opened my own firm of petroleum engineering consulting services from 1981 through 1984. Then, in mid-1984, I got a real job working for a small independent producer for the next 5 1/2 years. And then, in 1990, when they moved down to Dallas, I declined to transfer and became a consultant again and I've been a consulting petroleum engineer ever since.

My work has been primarily in reservoir engineering, and, so, I'm not a drilling engineer. I am not a production engineer. I am not a geologist. I am a reservoir engineer. And much of my work has been in the area of coalbed methane. Our clients in reservoir engineering have included both small companies and large companies, including such companies as Shell and BP, but also such groups as Red Willow, the Southern Ute Indian tribe. We do work for Nye County of Nevada. We've done projects for U.S.G.S., and one of our clients, historically, has also been a group called the, "Colorado Oil and Gas Conservation Commission," although I am not currently doing any work for them right now. And I have testified in front of the Colorado Commission on approximately 10 instances, and I've also testified as an expert before the New Mexico Commission several times, the North Dakota

Industrial Commission, and even once in front of the Nebraska Oil and Gas Commission.

Q All right. Could you briefly describe your past activities as a petroleum engineer relative to the operation of the Leyden Gas Storage Facility?

A All right. At Leyden, I first became involved in late 1995, after a well test had been run on Leyden No. 31. I evaluated and interpreted that well test for Public Service Company of Colorado, and assisted them in designing additional testing of that well. I then evaluated the other test of that well. And as they drilled additional wells in the area, I assisted in evaluating the results of the additional wells, clear up to and including Well 36, which was the last well drilled.

In addition, I assisted them in attempting to analyze or model that reservoir, and I have also worked for them as an expert testifying in petroleum engineering related to Leyden in various lawsuits, and at the buffer zone expansion hearing before this Commission -- or before the Colorado Commission in 1999.

Q Do you belong to any professional societies or organizations?

A Yes, I do. I am a member of the Society of Petroleum Engineers, the Society of Petroleum Evaluation Engineers, the Society of Professional Well Log Analysts, the Rocky Mountain Association of Geologists, and I am a Colorado Registered Professional Engineer.

Q Thank you.

MR. KEEFE: We would tender Mr. Cox as an expert witness in petroleum engineering for purposes of this hearing.

CHAIRMAN MUELLER: Yes. He is accepted as an expert in the field of reservoir engineering. Thank you.

MR. KEEFE: Thank you, Mr. Chairman.

BY MR. KEEFE:

Q Mr. Cox, have you been retained by my firm as a consultant and expert witness in connection with Public Service Company's application before this Commission?

A Yes, I have.

Q And did you prepare a report in connection with this application which explains, in detail, your analysis of the engineering issues relative to the closure of the facility and the adequacy of the closure plan proposed by Public Service Company?

A Yes, I did.

Q And I would hand you a copy of that report, and ask that you identify that it's the same report and ask the reporter to mark it as Exhibit C-20.

A Yes. This is a copy of my report.

(Whereupon Exhibit No. C-20 was marked for identification.)

BY MR. KEEFE:

Q And did you prepare, or have prepared, under your supervision and control, any exhibits to assist you in your testimony today?

A Yes, I did. Exhibits No. C-1 through C-19.

Q All right. Now, before we get into some of the specifics of your report, could you tell the Commission what you focussed on in particular in order to arrive at your conclusions relative to closure of the facility?

A There were five main topics that I was asked to address. Those were the locations of natural gas, where it is stored in the facility. The second one was the potential for leakage or migration of gas out of the facility. The third topic was to assess and opine on the methods to be used to abandons wells. The fourth topic was to evaluate the amount of gas remaining in the facility at closure, and by closure here, what I mean, in the calculations that I've done, is the point at which the water level in the facility has reached the casing shoe of the highest well in the facility. And then, finally, to evaluate the proposed use of the facility for water storage.

Q All right. Let's start with the mechanics of natural gas storage at the facility. Would you please describe them for the Commission.

A Yes, I will. I have here several pictures, and let me first move to the map, if you will. This is Exhibit No. C-1, and what this shows is a map of the facility with a conceptual cross section from the northwest, beginning at Well 32, moving through 34 and 31, then kind of jogging to the west a bit, through Well 17 and Mine Hole No. 19. Then moving back to the southeast through Shaft No. 4 and Well No. 36. The reasons for choosing this particular cross section will become clear here shortly, but, again, taking and looking at where gas is stored and where it is located in this facility, understanding conceptually first where gas can be located, to me, was the first necessary step.

So, if we then move -- you'll have to skip down to Exhibit No. C-6 in your book. What I've done is I've drawn this conceptual cross section to show, first, what the facility looked like underground prior to any mining activity. So, this would be since mining began, about 1903, this would be what the underground section looked like, say, around 1900. And let me emphasize that this is a conceptual cross section. So, I'm trying to identify processes and locations where gas occurred.

Now, I have a 4-to-1 vertical exaggeration in this section. And the reason for that is that way I can see the impact of the different intervals, because, otherwise, if this was scrunched down to a factor of 4, everything would be very close to each other. And, so, by expanding the vertical scale, then I can see or I can demonstrate the differences and distances between the beds.

Now, the key things, on this first conceptual cross section, to look at, first, are the topography. We're looking at a higher topography to the northwest. And, as we move to the southeast, we're -- the surface line up here on top is generally dropping to the southeast, and we have two big cuts at Barbara Gulch and Leyden Gulch. These are fairly substantial cuts into the surface there. Then about 500 to 700 feet of Upper and Middle Laramie.

Now, there's some near-surface deposit that Mr. Hesemann will talk about. I'm primarily focussed on other deposits here and you'll notice I've called it the "Upper" and "Middle Larimer" here. "U" and "M" stands for upper and middle. Some of the geologists who have looked at this in the past have split the upper Laramie into two pieces; however, they are both the same types of claystones and shales and siltstones, with a few sandstones in there, but primarily impermeable rock from the surface down to the top of the Lower Laramie.

Now, the Lower Laramie extends from the bottom of the Upper Laramie down to the top of the Fox Hills. The Fox Hills here is the main aquifer unit in the area. So, the Fox Hills is where people are drilling the water wells, primarily, in this area. They are also completing them, many times, in the Lower Laramie, but because the Fox Hills is much more of a blanket sands, with much greater extent and higher porosity and permeability, virtually all of the water that's coming into those water wells comes from the Fox Hills.

Now, within the Lower Laramie, I've shown two coal seams, the A seam, which is the upper one, and B seam, which is the lower one, going completely across here. Now, in general, what we find in this type of setting, from a reservoir engineering standpoint, is that coal seams tend to have much greater continuity and are much easier to correlate from one point to the next. The sandstones, on the other hand, such as this, what I've identified as this Z-2 sandstone here, and Well 36 sandstone, tend to have much shorter lateral aerial extent than the coals.

So, what I've shown here, then, there are literally dozens of other sandstones and there are several other coalbeds in this interval as well. So the other main coal seam is called the "Nash seam," And it lies below the B seam. And between the B seam and the Fox Hills, there are a half dozen coal seams that are much thinner and have much less aerial extent than the others.

The other key thing I would point out on this particular cross section, you can see here I have now carried the B seam to the limits of this cross section, in my report, based on an interpretation from another geologist. I had felt that the B seam did not continue through Well 36, and Dr. Weimer, in his analysis, showed that it did. So, I've corrected these cross sections to show the B seam now continuing across this cross section.

Q Does that complete your discussion of Exhibit C-6?

A Yes, it does.

Q All right. What about Exhibit C-7? What does that tell us?

A Okay. Exhibit C-7 is showing conditions near the end of mining. So -- and in 1950, when mining halted. So now we see a number of different things that have happened.

First off, we see, for example, a shaft here, Shaft No. 4. Now, there are a total of four shafts. Three of them are into one mine or one seam or the other, whereas this shaft happens to get a connection between the two different mines, so -- the east mine and west mine. So, it's the only real connection, other than any rock collapse that's happened between those two mines.

Now, I've also shown here a couple of mined-out areas to the east of Shaft No. 4, and in this area, out over here, where we're looking at the mining being in the upper or A seam, whereas, to the west, it's in this second seem, the B seam. So, we have these different mined out areas. By the time 1950 had happened, there would have been some degree of roof collapse, at least in some local areas. So, there would have been a little bit of roof collapse occurring in some places.

Now, there are two other holes that I've shown here. And one of these I've marked as Drill Hole No. 4, which is one of the mine wells that was actually drilled from the surface down. And then we have Mine Hole No. 19, which was drilled from the mine. There it was drilled 118 feet up from the mine and 144 feet down from the mine. Now, the distinction between these different holes or wells is important. When we were talking about Well No. 36, that's actually a well that Public Service Company drilled. When we're talking Drill Hole No. 4, that is a hole that was drilled looking -- exploring for coal by the miners. And so it -- that was prior to Public Service coming in. That's why you see this occurring there in 1950.

Now, there were a number of these in-mine holes, drilled primarily in the '20s and '30s, in exploring for additional coal, because especially after the miners found out that they had -- they were actually in two different seams here. Originally, they thought they were in the same seam. Mining across, as they mined to the east from the B seam, they discovered they didn't come into the east mine workings. So they knew something had happened. So, they then drilled these other mine holes and drill holes to identify what had occurred. And that pretty well covers what I had from Exhibit No. C-7.

Q All right. Would you please move onto Exhibit C-8.

A Okay. In Exhibit C-8, around the time, now, of the start of storage, what we have is this rubble zone above the mined out areas where the roof has collapsed in the mine. And we have the, as that roof collapses, it forms rock falls within the mine. And they just kind of pile up until a distance that is typically oh, 50 or 60 feet above the mine workings and Mr. Sherman will be talking more about that, the exact distances.

Now, at this point in time, one thing that I don't show on this chart is what the water levels were. Obviously, during the time of mining, the miners pumped the water out. They -- it's hard to work in a mine if it's filled with water. Miners don't seem to like that. And, but, then, once they left the mine, it began refilling. Now, the amount of refilling that had occurred in the couple of shafts, Shaft No. 2, in particular, had come up about 200 feet. And, so, as you can see from the dip of these beds, water level coming up 200 feet would have been enough to completely fill the mine, except for a few isolated pockets of either air or methane that might be present there. So, this is the situation that we had at the start of storage in 1960 on Exhibit C-8.

Q All right. And I believe you have one more conceptual cross section. Is that C-10?

A Actually, it's C-9.

Q C-9?

A This is C-9. Now, I've put what we have for current conditions. So, now Public Service has drilled a number of wells within the cavern area of the mine area that they used for injection/withdrawals, and they have drilled many wells outside.

So here would be, for example, the location of Well 34. Well 32, which is shown in my report but not on this particular section, would be out at this location just west of well -- northwest of Well 34. You can see Well 31 occurs here, Well No. 17, and notice Well No. 17 is at the same location as Drill Hole No. 4. That's going to become important as we talk about gas migration or leakage. And then now we have Well No. 36 off to the southwest that intersects these Well No. 36 sands.

Q All right. Then let's move onto your study of the potential for gas leakage out of the facility. What did you find?

A Okay. What I found, the potential for gas leakage or migration out of the facility was, first off, I wanted to go back and look at the incidence of this over time. So, this is, if you'll move forwards now, in your booklet, back up towards the front, I identified six different instances with historic leaks from the facility. And these would be leaks or migration.

So, we have, first off, Well No. 17. Well No. 17, back in 1964, during one of the walking surveys that Public Service Company had done to search for potential leaks, they found bubbles under the ice in Barbara Gulch. It turned out that those bubbles were actually coming out of an old mine drill hole that had never been plugged.

Now, if you look back at this Exhibit C-1, you'll note that Well No. 17 here is actually outside the mine workings. So, one of the questions that comes up here is, well, if it's outside of the mine workings, why would it have gas in it? This is where the importance of the conceptual cross sections comes in, because if we look here at what happened with Well No. 17, what they did, Public Service came in and first cleaned out that old drill hole down to TD, then they went ahead and ended up filling that up and redrilling it as Observation Well No. 17. So this is at the exact same location as Drill Hole No. 4.

When we look at how did gas then get to Well No. 17, that's beyond the area of the mine workings, we see the explanation being that we have this Z-2 sandstone here that's connected across between where Well 17 is located and where the workings are.

Now, we also have this in-mine hole No. 19. One of the things that concerned me when I first noticed this was, I asked myself, if I'm a miner back in the 1920s and 1930s, how am I going to plug a hole that goes up in the roof of my mine, and this particular hole went up 118 feet.

Well, as it turns out, it went up to within just a few feet of the stratigraphic elevation of that Z-2 sandstone. So, whether it's that particular mine hole that leaked and allowed the gas to come up, or whether, in this case, the rubble zone came up there, or some of the tensional cracks, we have some connection, then, up to well -- the Z-2 sandstone that, then, that came over to this Well 17. That drill hole had been drilled down into the Fox Hills.

So, what we have, then, is when they began putting gas in, you're sitting there with an open wellbore here, and a sandstone that's connected. So, they just sat there. As they pressured up, obviously, that hole, the mine hole, or whether it was a mine hole or rubble, would quickly fill with gas, because this is up towards the top of the mine. And, so, then it filled with gas. Now you have gas coming out here and pushing, and you've got an open borehole, so water can fall down or be pushed out. And then the gas comes and ultimately comes up to the surface.

Now, it's very key to note here that every one of these instances historically has been what we call through "anthropogenic sources" or "anthropogenic causes." There's a manmade reason why this gas leaked out or migrated from the facility. And, in this case, the manmade reason is a combination of the mine hole here, or the rubble zone created after mining. So the mine itself and the drill hole that was drilled at Well 17.

So Public Service Company came in and cleaned out that old hole, cased and cemented it and completed it as an observation well. Now, we'll come back to this same spot in a little bit when we get to Well 31, but Well 17, we now have the understanding and explanation of why, for a well that was outside the mined area, why it had gas in it.

The next case was Shaft No. 2. Shaft No. 2, which is -- I don't actually -- over here, which is right here on the eastern -- in the eastern mine, began having bubbles in liner that Public Service observed in the mid-70's. So, what they did is they allowed the water level in the mine, in the east mine here, to raise up above the bottom of that shaft. Once there was water above the bottom of the shaft, there's no longer a pathway for gas to get through or to get out. So, that remedied that problem.

The third case was Well No. 23, which is up in the northeastern part of the facility here. Well No. 23 is right close to the edge of the mine workings, as it turns out. That's another old mine drill hole that was not plugged. And, so, some of these old mine holes like that, they didn't plug them because the miners didn't have anything coming out. Again, Public Service cleaned out the old hole, cased and cemented and completed it as an observation well.

The fourth instance is Well No. 27, which is over right here in the area of quite a few wells in the middle part here of the western mine. What happened here was, in 1990, they had drilled that well to evaluate a shallow gas zone that was found in Wells 25 and 26. It turned out it was storage gas. It was leaking through casing leaks in Wells 15 and 16. And so, they came in and squeezed off those leaks, set liners in 15 and 16, and Well 27, ever since, has had steady 15 psi pressure. So, there's no sign of any connection back to the cavern. It looks as though this problem has been completely fixed by working on Wells 15 and 16.

Then, we come to the problem well, the one that kind of opened everything up in 1993, Well No. 31, this is a ways north of the facility off here, north of the Barbara Gulch. So it's up in the northern part here, within -- still within the confines, though, of the area leased for the facility but well beyond the boundaries of the mine workings. And it had storage gas in the Z-2 sandstone.

I can just set it up here for now. Okay. I've got -- there we are. Okay. What I've done, Exhibit No. C-3 here shows, for the Commission, the well log and mud log information from Well 31. And what we have here, is, down in this area right here, drawing a red circle, about 662 feet to 668 feet, in this well, there's a small sandstone unit that Public Service's geologist designated as a Z-2 sandstone that contains gas in it. And so that has about 5 to 6 units of crossover on the neutron density log. That's very clearly present there. And over on the mud log, you can see there was a considerable mud log kick taken from that sandstone as well. So, this clearly has gas in it.

Now, the first question people asked, is it storage gas. So they pulled a sample off of it and after they complete the well, and indeed it is storage gas. So, here at this location, 662 feet below the ground surface, there's storage gas. But there was another question that came out; that is this storage gas had quite a bit of helium in it. Now, why would it have more helium in it than the rest of the facility?

It turns out that in the 1960s, and early 1970s, a considerable amount of the storage volume came from northern Texas and the Oklahoma Panhandle, and southwest Kansas, from the Hugerton Panhandle Field. That area has a higher amount of helium in it. With the development of the Denver Basin Wattenberg Field, and other fields, here, more recently in the mid-70's and late '70s, then they were able to buy another gas with less helium. So, current storage has less helium.

So, the sign that this gas has helium in it -- has more helium than the current gas is a clear sign that there is not a direct connection to the caverns or to the mine area, because, if there were, that gas would have equilibrated, just diffuse -- if you had a common gas leg between, this would have equilibrated and it would be regular storage gas. So, any explanation of what happened at Well 31 has to somehow account for the fact that this is old storage gas.

Now, this is an additional small pocket of gas. When Public Service Company did their first test here, they produced 54 -- or 540 cubic feet of gas and blew the well down. Now, the casing volume at the time was about 500 roughly. So, they were only getting a little bit of inflow from the formation. So, this is a relatively low permeability sandstone with a relatively small pocket of gas. So, I designed for them a test, and when I designed the test to flow the gas well, they said, oh, we have got a problem. It's not a gas well now. By the time that they got ready to run the test, the water level in this zone had risen above the perfs.

So, we're talking about a small pocket of gas here that is just sitting there. There is still a connection, but it's a relatively small connection back to the cavern. And there's no direct gas connection. So, this is a pocket of gas that migrated in here early in the life of the facility and hasn't moved since.

So, how could that have happened? Well, when we look here, when we look back at the conceptual cross section, now we can understand how that happened. This is the Z-2 sandstone in the same interval that shows gas on a log in Well 17. So -- and Well 17, it's thinned out to where there's only about a two-foot interval of gas that showed on the log in Well 17. And, so, what we have is this one case of migration into the Z-2 sandstone caused two of these cases of leakage or migration from the facility.

So, once they found gas in Well 31, Public Service then came out and drilled a number of additional wells, 32, 33, out over here, 34, 35, and Test Holes 1, 2, and 3. Now, again, we have different terminology here, a well versus a test hole.

A well is a well that's drilled and then cased and cemented. So, you actually have a well there. A test hole is drilled for information only. So they drilled down, got logs or other information, as the case may be, and then had to plug it. So, we have these three test holes and these additional wells.

Now, if I move to Exhibit No. C-5, I would like to show on that the results of those other holes that were drilled. So, Well No. 32, up to the northwest up here, it didn't have the Z-2 sandstone.

In fact, none of these other wells or holes have the Z-2 sandstone. There were no mud lug shows from that well. There was no neutron density crossovers. So, not only did that well not have any storage gas, it had no indications of any gas whatsoever.

When we look at Well No. 33, which is out to the east here, there are some mud log shows, very shallow, less than 100 feet deep, which are probably related to biologic activity in the very shallow zones there. And there is some natural CBM shows at 500 to 530 feet. Now, why do I call those "natural CBM shows," coalbed methane. The reason I call those natural is, first off, within the Denver Basin, there have been a number of wells that have drilled through this section and found -- where they have taken samples and they found gas contents up to as high as 24 standard cubic feet per ton.

Now, for those of us who have worked in the San Juan Basin for many years, 24 standard cubic feet per ton is very, very small. But for those of us who have also worked in the Powder River Basin, well there's lots of the Powder River Basin that's in that 20 or 30 standard cubic feet per ton range. This is low-grade coal, more similar to Powder River Basin coal than it is to San Juan Basin coal. So when we look at this, we're looking at relatively small kicks, relatively small volumes of gas in the coal. But there are these natural CBM shows, not just here, but in other wells around as well.

Now, Well No. 34, up to the north here, also had no shows of gas on mud logs, no neutron density crossovers, no gas. Well No. 35, which is right here just north of the boundaries of the facility, this was a well that had a one unit mud log show at 778 feet, which I have to question if that's a real show or not, based on my experience. One unit is so small that now we're into the level of interpretation of things. But it also had a number of crossovers, one point, typically on the neutron density log. Now, if you'll recall on the Well 31 well log, the crossover was five to six points. And one point variation, as it turns out, is a statistical variation. This particular log was one of the first logs of this type run in the basin. And it has much wider variability between the main log and repeat log than what we normally saw.

So, in this particular log we saw about two and a half points variation between the main log and repeat log on the neutron log. So, that's enough to give you some false crossovers on the neutron density log. So this a statistical variation. It's not an indication of storage gas.

Test Hole No. 1, in the south, no indications of storage gas. Test Hole No. 2, up to the northeast, had some intervals on mud log that showed a little bit of gas, anywhere from about 85 down to 348 feet. None of them showed up with gas on the neutron density log. Those mud log samples were too small to get a sample to determine whether it was storage gas or not. So, to me, I look at that, I say this is such a small show, I am not going to worry about it.

Test Hole No. 3, up here to the north, had some small CBM shows. And, again, you can see this, as they are drilling for coal, you are grinding up coal, it releases gas that's naturally present there. And then the Tosco water well, also up there to the north, up in this area here, that well, and actually I have in here on the mud log -- it did turn out there was a mud log. It had a show at about 600 feet which is several 100 feet above the coals. So, not related to the coal. And no neutron density crossover, but the key point here is Public Service came and took a sample from this well, which is completed in the Lower Laramie and Fox Hills and the sample showed no gas, no sign of storage gas.

So, what we have, then, is a whole bunch of wells that have no indications of storage gas, but back on the Exhibit No. C-2, we had this one other well, Well No. 36. And this is on the southern end of the facility, on the east side. And it did have gas in the sandstone with a relatively direct connection to the mine.

So, this particular instance here is right here, at about 782 to 790 feet. And you can see there's substantial crossover. So, here is a sand that's a relatively clean sand, that has a relatively direct connection to the mine. And over here the mud log is shifted about 10 feet from the well log, and so, the shows in here at about 870 feet and over the next 25 feet are actually from this sandstone here.

Q Which exhibit is that, please, Mr. Cox?

A Oh, excuse me. That's Exhibit No. C-4.

Q Okay.

A Thank you. Now, you can tell, it's shifted -- it's off about 10 feet because the coal intervals don't line up perfectly between the mud log and the well log. So, we have then an interval, then, here, in Well No. 36 now. Why do I say it has a relatively direct connection? Well, first off, the gas from that well has the same composition as current storage gas. It's not old gas. It's like current gas. Secondly, the pressure in that well rises and falls in step with pressure in the cavern. If the pressure in the cavern or in the mine goes up, the pressure in this well goes up. As the pressure in the facility goes down, the pressure in this well goes down.

So, Public Service ran a test of this well. And I interpreted that test and found that this zone has a permeability of about 270 millidarcies. So, fairly high permeability, and that we could see two parallel barriers or two parallel boundaries on that test. And that those boundaries indicated that this was in some sort of a channel that was approximately 300 to 400 feet wide.

Now, I can't quantify it from well testing any closer than that, because of the range of uncertainty in a well test, on distance too, because the years is fairly substantial. And so, we're looking in that 300 to 400 foot range, but that's very consistent, in my mind, to the thicknesses that Dr. Weimer has said these sand units should have from the geologic model.

So, what we have, then, is we have these half dozen instances, and on both Well 31 which is already been vented now, and Well 36, where ultimately this gas will be produced or vented. Then, those two instances, the remedy ultimately is to remove as much of the gas as possible.

Q That concludes this section. After closure, will the potential for gas leakage be reduced?

A Yes, it will.

Q Why is that?

A Well, there's several things that will enter in. The first one is that the sheer amount of gas will be greatly reduced, compared to the maximum amount of gas that was stored in this facility of about 3 BCF at any one time. That ultimately the amount of gas that's remaining here will be brought down to less than 200 million cubic feet. So that means about 93 plus percent of the gas that was in place will be removed.

Now, secondly, the gas that's remaining will be at much lower pressure, because, ultimately, the pressure ultimately, at the end of closure, should be brought down to -- close to atmospheric. You'll probably have about 5 psi over atmospheric. So you are down in the 20 psi range rather than typical rate operating pressure, averaging about 180. So, the pressure brought off -- about 90 percent of the pressure will be brought up off.

Then, another factor will be that a lot of that gas will be locked up in the immobile areas. Some of it will be locked up in the coal, as I talked about a bit, and in other areas where it has no chance to move. So, the lock up of the -- much of that remaining gas into immobile form is also going to help reduce any possibility for leakage or migration.

Then, the final factor is one of just simple area. Right now, the area out here that -- of this facility that contains gas is somewhere, ball park, in the 1,000 acre range. So, if you were to drill a well in much of this area, you would find gas today. Whereas, once it's filled up with water through most of it, then it's only in these isolated little attics up in the top, and in any trap gas areas, that you would find gas. So, the percentage of the area then that has gas will also be greatly reduced. So, all of these factors combine to make the risks in the future, after closure, much less than it is today

Q All right. Moving on, have you reviewed the methods to be used by Public Service Company under the plan to abandon wells?

A Yes, I have.

Q And, in your opinion, are those methods satisfactory?

A Yes. In fact, I would say they are more than satisfactory.

Q And why is that?

A Well, in most cases, in oil and gas wells, when we're abandoning wells, what we would do is go in and set several plugs at different depths within the well, so that we would then cut off the chance for migration and reduce any opportunity for fluids to move either way. Now, that also leaves the well available for relatively easy reentry, if someone were to come in and say I want to drill down to a deeper horizon and look for -- explore for oil and gas.

In this case, I think the key thing is that Public Service has said, first, that they are going to come in and set a plug at the bottom of each well, test the casing, make sure that they have the integrity of the casing, test for gas by logging, correct any problems, following Commission rules and guidelines, if they discover any gas behind the casing, and then, ultimately, fill the wells that they abandoned with cement clear down to the -- from the surface down to total depth.

Now, to my mind, that is a positive thing to do, and this is one area where, originally, I had made a recommendation that they consider setting plugs, but after thinking about it further, it's my opinion that completely filling the well is a better thing to do. This area is going to be used for water storage. We have shallow aquifers that are going to be used here for water production. That water needs to be protected. I don't want to see people coming in here 30 years from now and reentering a well that was potentially drilled originally in 1960, and trying to deepen through a mine zone, through a water reservoir, trying to go to a deeper zone. It's much better to plug it from surface to TD. That's what Public Service Company plans.

So, in my mind, what they have proposed here goes beyond normal regulations or normal practice and provides an additional protection for the aquifers.

Q All right. Now, moving on to an issue which seems to be uppermost in the Commission's mind today. Have you undertaken to estimate the amount of gas that would be left in the facility at closure?

A Yes, I have.

Q And could you please discuss that.

A Okay. First, what I did is I tried to identify areas or positions where that gas could be left, because if we can understand, first, the different locations where gas could be left, then I can begin to bracket or put numbers to it.

Now, I have Exhibit C-10 here, where I've identified four areas or four locations for gas in the facility at closure. First off will be any gas that's left within the mine's rubble zone, or connected sands, so these would generally be a much higher permeability setting, because collapsed rubble zone has fairly high permeability. And it would be free gas. So this would be gas, if you drilled into it, it could move.

The second area would be trapped free gas in inaccessible areas. This would be, for example, in one of these haulage ways, or one of these areas, as, for example, in the northern part. So sort of between the two mines, where there's no well. Any gas that's in that area is, as water advances, if the rubble zones don't connect, you could end up with trapped gas. So that's trapped free gas in inaccessible areas.

The third area would be gas trapped in unconnected or undrained sandstone lenses. So, we have already seen, in Well 31 up here, that there was sandstone lenses that gas got into it, and then could not be drained back into the mine. It's now an isolated pocket. So, the potential certainly exists that there may be other isolated pockets out there, for one reason or another.

And then the fourth piece is gas that would be absorbed in the coal because, from experience with coalbed methane, even in lower range coals, now, we know that coals can hold on to a certain amount of gas. So, evaluating the gas that's absorbed in the coal would be the fourth area.

Now, there would be other much more minor areas that I did not quantify as, for example, the remaining area between the casing shoe and in wells down to the bottom of a well, because a few wells out here is not going to add up to much volume. Another area, potentially, could be gas in solution, the water in the mine. That would only add a maximum, if the gas were -- or if the water were fully saturated with gas at the end of closure, would only add a few million cubic feet, and that gas would also be extremely low concentration. So there's no problem with it being a threat to the public or to anyone else.

So, these were the only four areas that I could identify where gas would be present in the facility after closure.

Q All right. Now, then, did you determine how much free gas would be left at closure under each of these scenarios? Did you quantify the amounts?

A Yes, I did. Let me move here, first,

to -- I'll look at the free gas in the mine rubble zone and connected sands. So, these would be sands -- like Well 36, for example. Most of that gas will be recovered as the pressure is brought down in the cavern.

So, what we'll have, though, is -- again, this is a conceptual cross section, Exhibit No. C-11. What we'll have is, as the water fills up the mine and the rubble zone, there still will be a little bit of gas left above the highest withdrawal point in the facility. This is what we call, "attic gas," above the point where we can pull it out.

Now, what I've done is I've drawn this conceptual section based on an understanding of the withdrawal points and the structure. So, if we take Dr. Weimer's Exhibit B-3, and look at this, we know that up here in the west mine, the highest withdrawal point will be Well No. 9, up here. And over in the east mine, the highest withdrawal point will be Well No. 5, which is right at that point. Now, you'll notice downdip in the east mine from Well No. 5, we're going about half a mile. Downdip of Well No. 9, in most of the west mine, we're going about three-quarters of a mile, and there's a little bit down here in the southwest portion of the mine that goes a little further.

For the sake of showing things conceptually, what I did is I just assumed that we would look at a lateral distance along the dip from these highest points of approximately a mile. So, you can see that this water-filled rubble zone is going to come up, then, most of the way, and all that's left is a small triangle of gas at the very top, once we filled up to the highest point -- withdrawal point.

Now, you'll also notice that this is kind of a conceptual type of thing; that, rather than being all of the way across the mine on these, we're looking at more like a small triangular part or much smaller part than the main, average cross section of these mines. And so, in actuality, if I would look at it on a volume basis, it will be even smaller. So, what I've done is I've just said, mentally, well, if -- when I put the pointer up here at half a mile, if the water has filled up half of it, then it would be -- half of it is still in the attic. If I'm at a quarter, then I have only 25 percent up there. Well, you can see here, from this conceptual cross section, it's clear that it will only be a few percent of gas left in that attic.

Now, in order to leave myself margin free error, then what I did is I assumed a maximum of 10 percent of the facility left in the attic.

Q Are you now looking -- referring to Exhibit C-12?

A Yes. I'm now going to move to Exhibit C-12. So, I'm saying we know the volume of the facility is -- the volume of coal that was removed, that was right at 150 million cubic feet of coal that was removed. The collapse of the roof and the formation of rubble piles still leaves about 150 million cubic feet, because we didn't have much ground subsidence, if any.

So, we have 150 million cubic feet total open volume. I've said 10 percent maximum in the facility in the attic. And I've said, at the point when withdrawals are done, this can be vented down to just a few psi over atmospheric pressure. So we would be down to a formation volume factor correction of about 1.33. Under these conditions, the maximum amount of gas left in that attic will still only be 20 million cubic feet. So, a relatively small volume, as oil and gas volumes go.

Q Did you also make similar calculations for the volume of gas trapped at closure in inaccessible areas?

A Yes, I did. And those calculations are summarized on Exhibit No. C-13. What I have here is, this is to account for those areas where the rubble zone may be irregular, or we may have areas where haulage ways were in such a way to trap a certain amount of gas.

And, so, what I have here, then, is I've said, okay, we're going to have some amount of trapped gas. Now, in a conventional water-driven gas reservoir, that would be a fairly high number. But here, that gas is driving through this rubble -- or the water is advancing through a rubble zone that has extremely high permeability, 10s of darcies of permeability within that rubble zone. So, the trapped gas here is not like trapped in individual pores, but rather trapped in small areas that, then, that it can't drain out of as the water slowly advances upward.

Now, in addition to that, another factor to consider here is, as that gas moves, or as water moves up, rather, then, it's covering most of the area. So, what I did was I said, let's look at a condition where I'm going to say, by the time we get done and we fill this facility with water, up to the highest drain point on each mine, that I am going to say 5 percent of gas is going to be left or trapped. Now, that was actually trapped at 20 psia. Then, as water continues to advance, then it's compressed, because, going back to Exhibit C-11, up at the top, if I have 20 psia, halfway down I'll be at about 63 psia, because I've dropped about 100 feet. And, at the bottom, I'll be at about 90 psia.

So, if I take it at the mid-point of the area where it's trapped, I'm going to be about 63 psia, then that's equivalent to saying, if I trapped at 20, I have 15 percent of the volume of this reservoir originally filled with gas that got trapped and then that volume will change to a third of that, leaving me 55 percent trapped.

So, on Exhibit C-13 here, I then have 150 million cubic feet open, 5 percent trapped volume and this, I feel, is the maximum, and then a volume factor now of 4.21, because, on average, that gas is trapped behind water, so it's at greater -- it has water head on top of it as well as the pressure. So, that leaves me still only 32 million cubic feet maximum trapped and inaccessible gas

Q Okay. You mentioned, also, gas remaining in the sandstone, Z-2 sandstone system that, for one reason or another, don't get depleted by the time of closure. How much gas will there be in such units?

A Okay. I've calculated that on Exhibit

No. C-14. Now, in some ways, this is the most difficult portion of the gas remaining to attempt to quantify. So, what I've done is I've said, once again, let's try and look at some extreme cases.

So, first off, I said, let's say that we have 10 sand lenses out there that are completely 100 percent filled with gas, but that, for one reason or another, that gas got there, into them but can't get back. You could think of 10 sand lenses completely filled, or 20 sand lenses that are each half filled, or 40 sand lenses that are each a quarter filled, or so on. So, I am saying the equivalent of 10 sand lenses.

Now, on this, I have three million cubic feet of volume in each sand. The way I arrived at that is I said the sands are typically 10 feet thick. Based on Dr. Weimer's work, and other work that I've seen, they are typically 200 or 300 feet wide. So, I just said, let's pick 300 feet wide. And here's a typo. They are 1,000 feet long, not 100 feet long. So, they are 1,000 feet long. And the calculation here is based on the 1,000 foot of length. So, this is, then, a typical one of these small lenticular sand bodies out there, and whether it's 10 feet high and 300 feet wide or 15 feet wide and 200 feet wide, we would get the same result.

I've said, let's take and assume that it's completely filled with gas. So, 15 percent max gas filled porosity. And I'm going to assume that however that gas got in there, it got trapped at about the average pressure of the facility, not at closure but back during operations. So, I'm taking, again, trying to look at a worst case type of scenario here. Even so, when I come down, those type of sand lenses, because they are so small, can't hold much gas. Each lens, if it were completely full like that, would only hold about 5 1/2 million cubic feet. This total then comes out as 55 million cubic feet, again, a very small number in the scheme of things, considering the amount of gas that's gone in and out of this facility.

Q All right. Now the final place for gas in the facility at closure you mentioned is gas absorbed in the coal. And what do you mean by that and what calculations do you attribute to that?

A Gas absorbs in the coal. For anyone who is not familiar with coalbed methane, coal has carbon molecules that have -- methane has an affinity for those, and methane wants to stick to the carbon molecules, and that's a process we call, "absorption."

Now, I prepared an Exhibit No. C-15 to show, again, an indication of the level of gas that could be absorbed in the coal. We do this calculation, again, volumetrically. So we're saying how big is this tank, and, in this case, the tank is the area of the mine here. And we're looking at the coal that didn't get mined, because the coal that got mined was pulled out.

Now, we want to look at the coal that's still left there after mining, that gas has been in contact with, that could hold gas. Now, at the time of mining, about 6 million tons of coal were taken out of here. This is a 1903-to-1950 vintage mining. And so the indications are that about 60 percent would be left after the mining. And that number could be as high as 70 percent. If we look at the volumetrics of this area here, and just assign an average thickness of about 7 feet for the mined interval, we come out with a calculation, that it should be between 60 and 70 percent of the coal is still remaining there. So, that coal now has been -- was left there. It's in the distances between the mine or between the different workings in the mine, and some of it has collapsed.

So, we have, now -- let's assume that entire volume, which now would contain -- 9 million tons is available for coalbed methane -- or for storage gas to absorb, like coalbed methane, for example. At this rank of coal, at low pressure, say 20 psi, it can only hold a few cubic feet per ton. And this is consistent with the measured gas contents in the Denver Basin. Unfortunately, we don't have any isotherms for this coal, so we don't have an exact number. But this is relatively low-ranked coal, more similar to Powder River Basin than it is to the San Juan Basin or Raton. So, this 5 cubic feet per ton would be a typical gas kind of number for this low-ranked coal.

Then I said, let's multiply that by 2, because there are other coals that may be in the rubble pile. We have uncertainty as to the exact level, and, even so, when we multiply this out -- now this happens to be the biggest piece I've come up with. It's still only 90 million cubic feet. So, still a relatively small volume.

Q So, did you add up all of these values to get a total amount of gas to be left in the facility at the time of closure?

A Yes, I did. And that is shown here on Exhibit C-16. So I have, at closure, free gas in the mine rubble zone, in connected sands, 60 million cubic feet, and that is, to my thinking, a maximum number. Trapped free gas maximum of 32. Gas trapped in unconnected sandstone lenses, 55. And gas absorbed in the coal, 90, for a total not to exceed 197 million cubic feet.

Q Now, that number -- is that exact number to within plus or minus 1 MMCF, or to what accuracy do you give that number?

A Well, obviously, not to within plus or minus 1. But, I think it's a reasonable maximum level, because the free gas left in the mine will be a smaller number, because of geometry and because of the degree of connection between the rubble zone. So, I've estimated the maximum here at 20. That number could be, say, as little as half of that.

The free -- trapped free gas in inaccessible areas, 32, is based at 5 percent on -- at higher pressure, which is equivalent to 15 percent of this facility being filled at 20 psi. That's a huge number, relatively. The actual number will be less than that.

55 million in unconnected sandstone lenses. Again, I have tried to reach the maximum. That's assuming those lenses are completely filled with gas. So -- and we don't know of a single lens right now that were not not connected to, other than that Z-2 sandstone and in Well No. 31 or Well No. 17, both of which will be vented.

So, finally we come down to the gas absorbable in the coal. Again, this should be a reasonable upper limit. We don't have the numbers to define it better than that, but you add all of this together, that 197 is a maximum. The actual number should be substantially lower than that.

Q I notice you have another column. It says, "At May 1st, 2003." What's the purpose of that column?

A The purpose of that column is to check this methodology and procedure. And, so, what I've done is I've said okay, I made these calculations as to the amount of gas that could be there. Let's check and compare with the information we have to date. And so this calculation was done at May 1st. At that point in time, about one-third of the facility was filled with water and the facility was at 50 psig, which is about 62 or 63 psia. So, gauge pressure versus absolute. So, making those calculations, that free gas volume at that point in time should have been 419 million cubic feet.

Now, trapped free gas in inaccessible areas, because water injection is not yet started, that number should be very small, essentially zero, because we haven't trapped it yet. Gas trapped in unconnected sandstone lenses. I've said that number is probably similar before and after. I don't know where such lenses might be. I don't know why they are no longer connected, but let's just apply the same number. But then the other number, gas absorbed in the coal. Taking a range, because on the material balance pot, we saw from Mr. Uding's work a flat period there. I said, let's look at a coal that maybe takes a while to desorb. So, I said, let's do a number at 50 psi, which would lead to 198 million cubic feet, or about 150 psi, which would lead to 396. So, where I can't pick one number, I'm going to bracket the range and calculate.

These numbers added up together then indicate that, as of May 1, 2003, the facility should have had in it, volumetrically -- this is a completely independent calculation from what Mr. Uding had indicated -- a number of between 672 and 870 million cubic feet.

Now I do have one other number that I've shown here, which is during the period of production of gas, after last injection, so, from September 30, 2001 to May 2003, the facility produced 889 million cubic feet, which is more than half of the gas that was in the facility when they stopped injection has already been produced.

Q Have you been able to use other engineering methods to confirm or deny the figures that you have on this exhibit?

A Yes, I have.

Q And would you please explain that to the Commission.

A All right. And in looking at gas-in-place or reserves, as a reservoir engineer we typically have three tools that we work with. And those are volumetrics, which is the methodology applied on the calculations in exhibits -- the last five exhibits, whatever their numbers are. And so that's calculating based on the size of the sand lens or facility, and so on, so taking and making volumetric calculations is one method.

The second one we have is what's called, "material balance." So, we look at how pressures dropped as gas has been produced. And the third method that we normally look at is decline curves. Now, decline curves on this project, as a whole, are not useful for the simple reason that we aren't producing against a constant pressure and against constant operating conditions. Rather the production here is not limited by the rock but rather by the operations. And so, a decline curve doesn't help us here, but material balance issues will.

Q And do you have an exhibit which indicates your material balance calculations?

A Yes, I do. This is Exhibit C-17. And what this exhibit shows is a typical engineering type of material balance plot.

So, we have plotted pressure. In this case, it was pressure at Well No. 16, over here on the Y axis. And we would normally be taking what's called a, "Z factor correction". At these low pressures, we don't have to worry, today, about the Z factor correction. It's very minor.

So, I plot the pressure against cumulative production since the date of last injection, September 30th of '01. On this plot we see several different periods that I can identify that are important in understanding what's happening in the facility over the last two years. First, from October 1st of '01 through February 1st of '02, there's very little production in the facility, and yet the pressure dropped. Well, in a system that's fairly closed like this, what that has to be is gas moving from zones that have higher productivity into the main area here, or, excuse me, from zones having lower productivity into the main area of the facility that has higher productivity. So, this is like gas bleeding out of some of these sandstones units or gas perhaps desorbing from the coal. And so we get this equilibration going on here that we have gas coming in and out and equilibrating between the upper -- the higher productivity and lower productivity parts of the formation.

Then, we have, essentially, a straight line for the period from February 1st of '02 through August 1st of '02. So, a period of about six months there, where cumulative production and pressure in the facility are represented by nearly a straight line. A straight line on this type of plot is an indication the reservoir is acting volumetrically. We're just seeing production from -- in large volume from the reservoir, and that extrapolates out to about 1,000 million standard cubic feet or about 1 billion cubic feet here. Now, the amount that was remaining. So, to me, this is a showing that the higher productivity area, the majority of the facility were seeing draining from this -- during this period. Now, at that point, approximately 600 million cubic feet had been produced and the extrapolation is out to about 1,000 million cubic feet. So, that says that at that point in time there were still about 400 million cubic feet in this reservoir or in this facility available to be produced. Now, then, the pressure turned and ran relatively flat for the next several months. So, what's happening here is gas is now feeding in from lower productivity parts into the main part of the reservoir. Production rate is no longer high enough to offset that or to -- back in the earlier parts here, the production rates were higher because of higher pressures. Now these rates are much lower rates. So, now what we're seeing is some of that gas that's in lower productivity parts feeding back in.

And then, ultimately, out at the end here, we begin seeing a decline again. And what I've drawn out at the end is Mr. Uding's estimated remaining storage volume that he talked about earlier today, which is basically a book number, which, as of September 30th of '01 was 1,692 million standard cubic feet. That's a typo here on this plot. This, instead of '02 that's '01. And there's also a similar typo in my report.

So, what we have then is looking at how that line extrapolates through the later information, it's saying we're now seeing the remainder of this facility that is now draining. Now, Mr. Uding had prepared, in essence, this same information, only as a mirror image. So, I'll put that up.

This is his Exhibit A-2. And he has got more recent information. It's information through May 1st. You can see more recently, since May 1st, pressure is now beginning to decline again. Now if everything was acting volumetrically in this facility, then what we would have, and if the numbers is correct for ultimate gas storage, that volume there, what we would see is a separate line for this end information. And you can see it's not quite -- it's extrapolating to -- leaving some amount somewhere less than about 200 million cubic feet behind. So, this 200 million cubic feet, that would be extrapolated off of Mr. Uding's Exhibit A-2.

And if we cut that off -- now, recognize he's on psi gauge, I'm using psi atmospheric. So, his extrapolation there, when we carry it down to zero psi gauge, leaving about 200, if I extrapolate the last data, is similar to the 200 million cubic feet that I calculate here. However, part of this that I've calculated would be not accessible right now, the 50 million cubic feet, and in unconnected sandstone lenses. So, we're talking a range now, the 150 to 200 million cubic feet range, based on extrapolating material balance or from volumetrics. That tied together very well.

Q I believe you mentioned that the production decline curve analysis wouldn't be of much benefit when examining the cavern as a whole. Can that be useful in looking at individual wells and addressing this issue?

A Yes, it can. And in particular, Well No. 31. And I have prepared here Exhibit No. C-18, which shows the production decline curve for Well No. 31.

Now, we have here the production rate, daily production, on a logarithmic scale, as we normally do for this -- for a decline curve. So we got 10 at the bottom, 100 in the middle. If it had been up to 1,000, that would be at the top. Notice this rate is not in MCF per day like we normally use in oil and gas, but in cubic feet per day. So, this well never was capable of making very much gas. We're only talking a peak rate here, in around mid-2000, of about 150 cubic feet per day.

Now, since then the well has been declining. You can see, first off, a couple of interesting things. First off, you can see there had been a decline rate, and then a rise. That was because there was still a degree of pressure communication between the main facility and this small accumulation of gas. But then production declined rapidly to the point where out here, since early to mid-2002, the well's only able to produce intermittently. It has a 5 psi gauge controller on it. So if the pressure drops below that, it can't puff out gas. So we see on these rates, later on, here are some days that it's producing, and it's at this point capable of only making about 10 cubic feet per day.

Now, to put that into perspective, cows generate and belch out between 15 and 20 cubic feet per day for a full cycle. So we're talking this well now is making about, equivalent, less than 1 cow -- I think we can call it 1/2 cow unit of methane per day. And so, total production during this period, since this well has now been vented, it's still only about 70 MCF. So, the size of this pocket is much, much smaller than the size of a sand body. We're talking 70 MCF compared to -- I was calculating about 5 1/2 million cubic feet for a sand body, if a sand body was completely filled.

So, clearly, this sand body is not completely filled with gas. If we extrapolate this out, it's only going to ultimately recover, if it kept going like this, something less than 100 MCF of gas. So, a very small volume of gas.

Q All right. Did you compare the pressure response from various wells to determine which wells are -- or areas communicate with the facility?

A Yes, I did. And that's my final exhibit. Exhibit No. C-19. Now, what I have here in Exhibit C-19 is I've plotted pressures for a number of different wells compared to specifically the mine pressure. Now, let me point out, for all of the geologists and engineers here, who are used to seeing things converted to common datum, I specifically did not convert this to a common datum. What I wanted to do was to I wanted to look at pressures so that I could see if the pressure was in communication through a gas -- continuous gas phase, then I should see the same pressure, regardless of what my elevation is, because gas has very little head associated with it. It's just pressure that I'm looking at.

So, when I look here at the mine, and that pressure is measured either at Well 16 or Well No. 9, we see the mine pressure during the period that this report is based on, starting in late 1999, being, at its highest, about 250 psi, towards the end of the injection cycle. Then, during the withdrawal cycle, pressure has dropped down to about 100 psi. That's this red curve here. Then with injection, pressure came back up and you can see there are a few daily spikes here, because we're using particular wells and if a well nearby had injection, it would bump the pressure up. But, for the cavern as a whole, or mine as a whole, we're looking at reaching about 150 psi here. There's a short withdrawal period, more injection, and then since late -- this period right in here, then, since September 30th of '01, everything has been on production and pressure has either flattened out or declined, depending on the amount of production that's occurred.

Now, if we look at Well No. 36, which is the blue curve, you can see the pressure in Well No. 36 has been tracking generally with the pressure in the mine and has a delay of a month or so, month or two here between that pressure equilibrating. And that's the period it takes for the pressure wave to fully move through that sandstone, the rubble zone, whatever is connecting now between the mine and Well 36. But clearly, it is following a similar type of behavior as the mine pressure.

Now, when we look at the next curve up, Well No. 33, we have a completely different type of response. Well No. 33, this is in the Fox Hills, so this is based on water level at a certain depth here. And you can see it's relatively flat with some little wobbles in it. There's actually a little bit of decline, as Mr. Hesemann will talk about. You can see it easier on his presentation. But, we're not seeing the same type of response that we saw in Well 36. So, clearly we don't have gas coming out all of the way to Well 33. Now, the ups and downs here in Well 33's pressure are caused by a nearby water well.. When that pump goes on, the pressure drops in 33. When that pump goes off, in the nearby well, the pressure rises back up.

Now, the next curve is up -- two in particular I want to point out are Well No. 11 and Well No. 10. Well 11 and Well No. 10 are completed in the Upper Laramie. And so, one of these -- Well No. 11 is over here in the west mine, right there. Well No. 10 is over in the east mine, right here. And there's actually much earlier information, goes back more than a decade, from these two wells. The pressure or the head in these wells has continued to climb for the last 10 years. You see no indication of any impact from any of the cycling in the facility, which says the Upper Laramie is not in pressure communication with the facility. It is the seal. It shouldn't be in communication, and it's not.

Now we move to Well No. 31. This is the

Fox Hills in Well No. 31. So, this is not the Z-2 sandstone. This well is dully completed in the Fox Hills bottom and in the Z-2 sand. You can see the pressure in Well 31 is dropping and has been dropping somewhat. This is a result -- and likewise, on Well 31, 32 and Well 34, now, from the reduction in the pressure in the mine. That reduction in the pressure in the mine, if you remember the information, for example like over here at Well 36, we have the coal zones and we have the Fox Hills a short distance below those.

Now, if you think about what happens when we drop the pressure in the mine, we're dropping the pressure here, say, from 250 psi, now it's down to a level of 50 psi. So, we have dropped the pressure by 200 pounds per square inch. There are 1200 acres exposed or present on the floor of that mine. So, that 1200 acres, which is a lot of square inches, has had that much force removed from it.

Okay. That removal has caused an elastic rebound. That elastic rebound then causes water to move into -- through the Fox Hills, because it's an aquifer. This is a common factor in the groundwater industry. If you have two aquifer units, or if you have two units and you are only pumping one of them, you quite often see the response in the other unit through the elastic rebound. So, there's a pressure connection. It's not a flow connection though. So that's the reason why we're seeing these pressures decline in these other zones

Q All right. Changing subjects now for a second. Have you analyzed the proposed use of the facility for water storage?

A Yes, I have.

Q And would you please discuss that.

A Well, I see the use of this facility for water storage as being very positive. First off, it's taking an area with this mine and the wells that exist there, and making use of that again, so that the wells will remain useful for the water storage. This is an economic and beneficial use of those wells.

But on top of that, the facility would refill anyway, over time. It refilled during the time that -- from the end of mining until Public Service got into it. Of course today, now, the water levels drop more. There's -- more water has been pulled out of that aquifer. So, it would take it longer to refill if we did it today. But ultimately, this facility would refill anyway. So, by putting this water in, we're filling it up quicker, we reduce the chances for gas to come out. We displace lots of gas and all of that is very positive.

But, finally, I think, from the standpoint of reality, at the time that this facility is filled with water, it's going to have about 3400 acre-feet of water in it. That's a lot of water. And at some point, even if it were abandoned today, and completely, and not converted to water storage, that water is a resource that's, one, going to come back in the next drought and come after, at some point in time. So, it makes good sense, in order to move forward in a progressive fashion, now, it's beneficial for the City of Arvada, it's beneficial for Public Service, and I think it's beneficial for the people of this state, because it's going to push a lot more of that gas out more quickly, and allow this to become much safer, more rapidly, in that fashion.

Q All right. And, finally, in your expert opinion, Mr. Cox, will the closure plan submitted by Public Service Company protect public health, safety and welfare and protect the environment?

A Yes, it will.

MR. KEEFE: Mr. Chairman, I have no further questions of this witness at this time. And I would like to ask that Exhibits C-1 through C-22 be accepted into evidence.

CHAIRMAN MUELLER: Yes, they are accepted into evidence. Thank you.

MR. KEEFE: You know, I didn't do that with -- I'll guess I will do it at the end of the hearing. I want to get the resumes in today, but I will wait until the end of the hearing to get them all in at the same time.

CHAIRMAN MUELLER: That's fine.

MR. KEEFE: We would tender Mr. Cox to you for any questions that you might have at this time.

Could I ask, Mr. Chairman, do you have any idea what your timing was going to be today?

CHAIRMAN MUELLER: We're planning to go to at least six o'clock tonight.

MR. KEEFE: The reason I am asking, I don't know how long the questioning of Mr. Cox is going to take, but I prefer not to break up witnesses. But if we have to do that, we'll do that. In other words, have a witness start and not finish.

COMMISSIONER REAGAN: I agree.

CHAIRMAN MUELLER: I understand. I think the question, we have been going for about an hour and a half now, a little bit longer. Do we want to take a quick break, 10 minutes, no more, come back and go through other questions and then see where we are?

MR. KEEFE: I know Harriet would appreciate it.

CHAIRMAN MUELLER: Let's do that. Ten minutes.

(Recess.)

CHAIRMAN MUELLER: May we proceed? All right. Commissioner Reaganagan.

EXAMINATION

BY COMMISSIONER REAGAN:

Q Yes. I have a few questions. Some of them will be disjointed, and, Dave, you may ask some of your associates to fill in the blanks. Part of your discussion had to do with water wells drilled into the Fox Hills.

A Correct.

Q Okay. And this question might have been asked earlier, but I don't think we got an answer. How many homeowners in this area drilled water wells into the Fox Hills? Is it a customary thing that they would do this, do you know?

A I defer that question to Mr. Hesemann. He's the hydrologist.

Q He is a hydrologist?

A Yes.

Q Okay. Okay. This one also is probably one you might want to pass on. But the City of Arvada is present, so, will the City of Arvada allow homeowners to develop real estate above the water storage facility, once it gets in effect?

MR. FLOYD: I have no reason not to. I believe we will. However, I would like to point out that about half of that land belongs to us, and we do not plan to develop it.

COMMISSIONER REAGAN: Okay. The reason I'm asking the question has to do with how many people are going to come along in the future and drill water wells. And I think that is one of the issues, I think, that needs to be addressed before we conclude, if there's concern about the migration of gas. Okay, Dave.

BY COMMISSIONER REAGAN:

Q Well 36, you confirmed that's connected to the main storage reservoir.

A Right.

Q And in there you talked about the fact that you were engaged to run some tests to locate the barriers. And I guess I'm going to ask you the procedure that was used. Were these conventional either pressure buildup or pressure drawdown tests trying to find reservoir barriers in these very small, isolated sands?

A No. Actually it was just a conventional gas well test and in evaluating the test, the signs of the barriers were evident in the pressure response, so it was a short drawdown. It's about 800 MCF per day, for, if I remember right, about six hours. Then a buildup and later followed by a longer-term \drawdown\draw down and buildup.

Q That was a standard test that you used?

A Right.

MR. FLOYD: Excuse me. May I add something, since you covered it again.

COMMISSIONER REAGAN: Yes.

MR. FLOYD: In Arvada, we do not allow water wells. If they have a well before they annex into Arvada, it's grandfathered in, but drilling of new wells in Arvada is not allowed. You have to deed all of the indigent water rights to the City of Arvada. That's a stipulation of the --

COMMISSIONER REAGAN: That would say, then, it's not such a significant danger that a huge number of water wells are ever going to be drilled over this facility?

MR. FLOYD: The only ones that were being drilled would be the areas outside of the City over which we have no control.

CHAIRMAN MUELLER: Mr. Floyd, I apologize. Oversight. We haven't sworn you in as a witness.

MR. KEEFE: Yes. He was sworn in.

COMMISSIONER REAGAN: We did that this morning. Yes, we did. It's okay.

BY COMMISSIONER REAGAN:

Q Okay. I believe -- I think you've agreed that the, let's call it the "bulk volume of the cavern," is about 3,000 MMCF based on --

A 3,000 MMCF at 250 psi.

Q Okay. If that's the indication, then, basically the amount of gas that's left when you're finished at 197 MMCF, if my arithmetic is right, that's about 6 1/2 percent of the original volume, which is pretty minuscule.

A I agree, yes.

Q Okay. I'm trying to quantify things now. Petroleum engineers don't think in acre-feet. They think in barrels. Okay. So, for the benefit of the rest of you, 3400 acre-feet, Dave, is 26.3 million barrels of water. If that's how many acre-feet are here, that's how much water will be in this reservoir when it's full.

And in reading this, I believe I saw somewhere that the additional volume that you think you put in here is about 2200 acre-feet; is that right?

A That's correct.

Q That's about 16 1/2 million barrels of water that you are going to put back into this reservoir. So, I would echo what Dave already confirmed; that this facility used as a water storage reservoir is really a magnificent thing. It does lots of things for a lot of people, including the City of Arvada. I guess I would just like to confirm that.

A Yes, I agree. And the difference between the 2100 or 2200 acre-feet to fill it up versus 3400 that will ultimately be in there is because, right now, the facility is roughly 1/3 filled with water.

Q Right. Okay.

COMMISSIONER REAGAN: I guess I have no further questions.

EXAMINATION

BY COMMISSIONER SHOOK:

Q I don't really have any questions, I guess, except that I'm wondering if, as was testified to earlier, the mine's total capacity was 3 billion -- is that cubic feet?

A Three billion standard cubic feet, yes.
Q Okay. Could you not go back to the date that it was last considered to be full and do some arithmetic and see how much more was added and how much has been taken out or -- to come to some figure of what might be left as well as --
A Yes. Basically, that's what Mr. Uding had done in his calculations of what went in versus what came out, and then the corrections for the L&U gas following from there. But what I did was a completely separate and completely independent analysis, from the material balance end and from a volumetric end. So, we really have multiple ways of coming up with the amount of gas that's there at this point.
Q Right. Yeah.
COMMISSIONER SHOOK: I don't have any other questions.

EXAMINATION

BY COMMISSIONER CREE:
Q Just a couple of things from my standpoint. And it's interesting because maybe, at least from my focus of what I've heard, maybe I am focusing on an incorrect area here, but you spent a lot of time convincing us that the amount of gas that's left in there is small. And part of me was hoping that

what you were going to show was larger, because then that would address the issue of this 3 BCF that's missing. And maybe we'll just focus on that and that's the wrong focus.

But you a spent lot of time saying, look, there's only a little bit here, there's a little bit there, this could have went back into the into the coals and there's nothing -- that doesn't seem to be, at least if I was a homeowner around this area, that's not what I would be concerned with in terms of what's left there, because the areas that you identified are pockets that should never cause a problem. It's really the unknown that seems to be the scarier part, if I were a homeowner in this area. And you didn't spend anytime kind of talking about that. And, hopefully, maybe tomorrow, you know, in closing or whatever, we'll get some more of that information in terms of how much may have been used and where that might, you know, where that 3 BCF might have gone.

Is there any chance that it's somewhere outside? Um, you kind of focus on where it would be left inside. You know, we are -- we heard from Dr. Weimer that it probably didn't go far out and away from this area. Do you support that?

A Yes, I do. The -- I think there's two

pieces to your comments here, your questions here. The one piece is the lost and unaccounted for gas, which really and truly it sounds scary, but it's not. You know, when you look at it, year to year, you know, 3 billion cubic feet over 43 years is less than 100 million cubic feet a year. It's only a few percent. And as mentioned earlier, that amount of error on considering those big orifice plates, and the fact that, you know, at times the rates going in and out were, you know, 10 and 5 and 20 million cubic feet a day, and those meters were set up to meter 200 million cubic feet a day, the measurement error alone, when you take numbers that have a likely error of 3 or 4 percent, and you subtract two numbers, each of which has that error, the number you end up with then is subject to much greater error and --

Q You are right.

A So the -- but I can tell you 17,000 horsepower is a lot of horsepower and uses a lot of gas. And, so, I don't have those numbers. What I did is I came out at it a different way. But the amount of gas that is left underground, wherever it's at, that's what that unconnected gas -- what I was trying to quantify there.

We know that these sand bodies have

limited extent. We know that the coal is basically impermeable. Back in the 1960 hearing, the chief mine inspector for the State of Colorado testified that they had seen no connection between mines that were as close as 100 feet apart. That's telling me that this coal is essentially impermeable. If they even had a permeability of a full millidarcy, we would have been looking at numbers of half a billion cubic feet a year type of numbers being lost out of the mine, and every -- those would have been moving out rather than moving out and coming back and balancing out, so. . .

Q Sure.

A Given that that lost and unaccounted for gas is really more of a bookkeeping kind of thing, and the fact that fuel gas is not subtracted from that, and was not metered, tells me we can't get to a whole lot better number than that. It's somewhere between zero and, you know, whatever it is.

And this number of 50 million cubic feet calculated for the unconnected sands, remember, as we pulled this down, anything that has connection back to the cavern is going to be depleted. The pressure has already been pulled down to less than 20 percent of what the peak pressure had been, so --

Q Sure.

A We will be pulling out the gas and in as far as it can be gotten, but those seals and these -- both the sands and coals are very good seals.

Q Okay. Thank you. Couple of other questions. On your Exhibit C-11, which shows a depiction of the water filling up and then the attic gas.

A Yes.

Q For a nontechnical guy, obviously, the water is not going to stop right there. At some point the water is going to continue and it's going to fill all of the way to the top. What happens to that gas?

A It won't fill it all of the way to the top. Any pocket of gas that's left like that simply compresses as more head is put on and --

Q Won't let the water come up because it's there?

A The water will come up a little bit more.

Q Won't push it out somewhere else?

A As long as we don't exceed the, basically, the fracturing pressure of the seal there, then it won't go anywhere else. It will just sit there, again, as an isolated pocket that doesn't move.

Q What would cause -- what event could cause the pressure to exceed a fracturing point of the seal?

A Well, the pressure in the water system would then have to be pumped up to where you pump the pressure up higher than the surface. And you have to put a big pump out there to pump water in.

Q So you -- it would be -- it wouldn't be a situation where we talk about how it refills itself, other than the City of Arvada putting water in, the seepage of water in over the last several years, or, you know, actually it's a nine year period between the time that the coal mining stopped and when this was -- reservoir filled up. Just the fact it's filling up would not be strong enough to push that somewhere else?

A No, I didn't bring it up before, but you do bring up a point that I would like to make. That pocket will not ultimately sit there forever, because some day the City of Arvada is going to pull that water back out. When they do, those little pockets are all going to expand again, and then that gas is going to be recovered, even from those little pockets. The first time they drain that reservoir, they are going to get quite a bit of the remaining gas at that point in time. And then when they refill it again, it's going to be essentially displaced again and it will be gone.

Q Okay. That kind of leads to my last

question. Before I get to my last question, was there anything in your report that you pointed out that -- any recommendations -- I kind of asked this to Bill earlier -- anything from your report that you recommended that they pushed back on and weren't willing to do?

A Yes, there were. And actually I'll need to get my report back. I had three recommendations there, at the end of my report, and let me read those for you here.

First off, I had said -- my first recommendation referred to the potential hazard from possible future drilling. And I commented that if the City of Arvada or any other parties drill new water wells in the vicinity of the facility, they should use blowout prevention equipment. So, that's come up with other experts and, you know, Public Service has recommended that at this point. And I -- my recommendation had been within about half a mile from the workings, because I saw the limits of the sand bodies as typically being about 1,000 feet out. And so I am saying, if you go out more than twice that, you've got a margin of safety, an extra margin of safety.

The second potential hazard dealt with contemplated future operation of the facility for water storage. This question of the first time they drain it, they are going to get a little bit of gas. And we have talked with the City of Arvada and had meetings with them to talk about how they need to handle the -- a little bit of gas like that that comes out. It's going to be a small rate that won't be economic, but they still need to handle it from a safety standpoint when they are producing. And Mr. Hesemann has some recommendations on what they need to do, monitoringwise, on that. And so, my recommendation there ended up basically being subsumed into his recommendation.

And then the third potential hazard was towards maintaining the facility seal. My recommendation was that water storage operating pressures should be kept at a pressure below the fracturing pressure of the cap rock at all times. So that's on -- along the lines of what we just discussed

Q Okay. Great. Um, so what wells -- when they lower the amount of water and gas comes out, the gas comes out of wells they now designate as water wells, is that where the gas will actually come out?

A Well, I think what will ultimately happen is the highest wells in the structure are the ones that will get a little gassy quicker. And, so, as long as they vent those wells, and ultimately allow air to move in, the air is going to displace some methane and they won't have a problem from there.

Q Aren't those going to be plugged pretty quickly?

A Well, there's -- we'll have to pull up Mr. Uding's exhibit. I don't have the --

Q But, so, I mean, looking right now, there are several wells that obviously are being plugged and several that are left as observation monitoring wells and some that are water storage. So, when you mentioned it, when they pull it back out, gas is going to kind of generate. A question for me, where does it come out and of which well?

A Well, specifically --

Q Or which wells could it, because, obviously, you said if it moves off, it's going to be somewhere up in the north.

A Right. So, see, the reply here being water storage wells -- Well No. 9 is the highest well in the west mine, so that will still be there for water storage. Well No. 5 is the highest well in the east mine. That will still be there. So, as long as those two wells are there, for the gas to come out from those, until they actually pull the water level down below other wells, by which point in time there would have been dropped gas pressure substantially, then they won't be seeing any gas in those other wells.

Q Sure. But as long they keep those other ones available, that's where the gas will come out?

A Right.

Q First?

A That's correct.

Q Is it because they are highest?

A That's correct.

Q Great. And then the three observation wells. Any reason why, from your standpoint, that they would ever want to leave those observation wells for more than two years? Can you think of any reason, or is two years enough time?

A Well, that's one of those kinds of questions, you know, I don't know. I would say on that, I defer that question to Mr. Hesemann from a water standpoint of monitoring. From a gas standpoint, you know, the Well No. 36, there, which is one of those set as a monitor, to be P&A'd. . .

Q Will be covered up fast with water?

A Well, except, see, in that sandstone, the Fox Hills already has water. So, it's a dually completed well on that one, because it has some gas. I think, ultimately, you're better off venting that gas and plugging it so that you don't have a conduit for any remaining gas to come up.

Well No. 33 is a long way from the facility. So from a gas standpoint, I don't see that as being a necessary monitor. Well No. 34, up here, which is the other one that's been recommended, again, it's quite a ways from the facility. It doesn't have any gas now. As long as it has no gas, from a gas standpoint, I don't see a reason to continue it for monitoring. From a water standpoint, though, the water people may want it longer.

Q Great.

COMMISSIONER CREE: Thank you very much.

EXAMINATION

BY CHAIRMAN MUELLER:

Q Okay. Mr. Cox, I have kind of a bottom-line type of question for you. In your figure, your Exhibit C-17, this is the material balance, the leveling out at -- between, let's see, 600 and let's say 850 million cubic feet of production, indicates a different type of permeabilities or basically draining a different type of zone than just the main cavern. That was, I believe, your testimony earlier.

A Yeah. I was saying that the draining

within that cavern, or within that rubble zone and the connected sands -- remember, we have -- the facility is, really, the Lower Laramie system above the mine. Then we have -- some of it has extremely high permeability. Other parts have lower permeability.

Normally, when we see a flattening like that, in conventional gas reservoirs, we would say, oh, we have water drive. Well, the amount of water that comes into this facility is extremely limited. The amount of water coming in has typically been about 35 gallons a minute. So, that, for us oil folks, that's 1200 barrels a day, which takes a long time to fill up, the 26 million barrels that Tom calculated earlier, something like 40 years. And so, the water, it's not a water influx.

So we have to have ask, then, what other things can it be. The main part of the facility has such high permeability that it's beyond what we normally measure for permeability. It's broken rock.

Q Infinite.

A So, anything that's not broken rock like that, close to infinite permeability, has a restriction and then takes an infinite period to bleed out, and this, whether it's permeability driven or whether it's some of the gas desorbing from the coal, and taking a longer time to desorb from the coal, I don't know. We can't determine that with the information we have.

Q My question is, would it be -- could we see, if this continued on, on down this red line, might we see another flattening with an -- as we approach the, essentially, the permeability of another layer, or another type of storage mechanism within there, the question really being, should the pressure be taken down to a lower pressure before water is started to be injected into the system? Would more gas be recovered?

A I think the answer would have to be, yes, more would be recovered, but it would delay the conversion of this facility, then, to water storage and you wouldn't get the displacement the same way, or you would delay the displacement of gas that water will displace. So it's a trade-off between those different pieces.

So, yes, the longer the wait, the more those -- the gas that got out further or into tighter rock will bleed in. So that's the trade-off there. And that's really more of a matter of operations from a reservoir standpoint. I don't know that it makes a whole lot of difference.

Q Okay.

CHAIRMAN MUELLER: Thank you.

THE WITNESS: All right.

EXAMINATION

BY COMMISSIONER KLISH:

Q I would just ask for a little clarification on Exhibit C-19.

A Yes, sir.

Q It's obvious that Well 36 is tied into the mine cavity there. I don't quite understand the other ones. They look like their pressure is 200 plus psi. Can they maintain that?

A Yes. We don't have a direct connection between those other monitors and the mine itself.

Q So, what's keeping the pressure up?

A Well, the pressure in the aquifer system outside of the mine is higher than it is inside the mine. They have been pumping water now for 43 years there.

Q Okay.

A When we talk the Fox Hills -- and several of these are Fox Hills monitors -- that's really a different aquifer than what the mine is located in, even though it's all, from a technical standpoint, it's called the "Laramie-Fox Hills Aquifer," or the "Lower Laramie/Fox Hills Aquifer", really and truly. The Lower Laramie that's in the mine here has nowhere near the properties of the Fox Hills here.

COMMISSIONER KLISH: Okay. Thank you.

EXAMINATION

BY COMMISSIONER CASEY:

Q Maybe you can explain to me a little bit -- I'm not sure exactly how to ask this question, but I'm having trouble understanding exactly the geometry of these different reservoir compartments, I guess. Is, for a lack of another word, did you characterize the connectivity between the different wells so that you had some, I don't know, quantitative method to know how much connectivity there is between the different wells, so that -- because it appears to me, from what you are saying, that there will be different compartments that are sort of isolated and they will be left behind.

The way I envision this, that it's like a water flood and you're creating artificial gas reservoirs that you hopefully sweep out most of the gas through. There's areas that -- in the sandstones that will be left behind. Do you see what I am saying? There will be little like almost sandstone traps, stratigraphic traps, where you can't get the gas out due to the current configuration of the withdrawal wells.

A Right. It's not really the current configuration of the withdrawal wells. It's -- the coal was typically eight feet, say, and they mined that out, because that rubble zone extends up typically 60 feet above the coal and contains some sandstone intervals. Now, within the mine and where you have the breaks in the rubble zone, you have basically infinite permeability, so you don't have a case where one well doesn't talk to the other. If it's talking to the mine, they are all talking to each other. They are all in communication with each other, because of that extremely high permeability of that broken-up rock.

But then those isolated sandstone units, as you are saying, any of those that don't, for whatever reason -- maybe they once connected to the mine and they don't anymore, or if the water level raises and cuts off their connection to the mine, then that gas is going to be left trapped there by the system, either by the lack of connection now or by the water advancing up. And so, indeed, those are trapped areas. Trap volume like that, that will be left behind. And it is like sort of like a stratigraphic trap. The gas migrated in and it can't come out, for whatever reason.

Q So, I don't understand why, when you drop the water level with withdrawal during a drought, you know, sometime in the future, why would you get gas out? That doesn't make sense to me. I mean, I could see there would be some in solution, but if there are updip traps that you can't get out now, why would you get it out at some point in the future?

A Let me refer you back to this Exhibit C-16 here. That free gas, right there, 20 million cubic feet, is gas that would be left behind that is mobile. So, once that water is pulled back out, that gas will be expanding and so that gas will be mobile.

Q The free gas, what's it trapped in?

A It's just trapped above the highest withdrawal point in the facility. Then, when the water levels dropped again, then that gas is now exposed back to those withdrawal points.

Q So, there's no -- there's no Public Service wells that are drilled into that area in order to deplete that gas?

A Well, not -- the system hasn't been closed yet. So we're not at closure. It's not filled back up with water. The free gas there will be the gas trapped above the wells, and in that little attic up at the very top. And that will come back out. The majority of that will be recovered the first time that they drain this water reservoir, once it's filled up.

Likewise, the trapped free gas in inaccessible areas at 3 million, once they drop that water level again, if they pump it down, then that gas is going to expand and reconnect and will, again, most of that will be recovered. So, then you have unconnected sandstone lenses, any of those where the connection is reestablished by dropping the water level, then they're going to feed back into the mine as well. So, a lot of that gas may come out when they cycle the water back out as well.

And then, finally, the gas absorbed in coal, since ultimately, unless they put something else in, then this system is going to fill with air, and then the nitrogen in the air is going to be displacing methane out of the coal like that. And, so, most of that will ultimately displace out as well. So, all you are going to have left then will be whatever few isolated -- you can think of them as the stratigraphic kind of traps, or, for whatever reason, they are isolated, either because they had a connection that's gone, like the Z-2 sandstone in Well 31, or because they never -- they never dropped the water level far enough down to get the gas back connected to the mine. That will be all that's left long-term. Now, we're talking about long after closure, though.

Q So, the 197 million cubic feet, is that a function of starting the flood before all of the gas is actually drawn down to what it ultimately could be; is that correct?

A That's correct, yes.

Q How much is that gas worth?

A That's a combination of gas prices and bookkeeping. And so, I'm not the person to answer that. I don't know that.

Q Have you looked into any mechanism to recover some of that gas by drilling additional wells?

A Well, the wells out here, you know, cost $100,000 plus for Public Service to drill a well, but they don't own the land. And so, when you are talking 197 million cubic feet maximum, that if you, instead, taking the maximum, if you took more reasonable kind of numbers or middle-of-the-road kind of numbers, that number might be 100 million cubic feet, spread in all different kinds of things. You can't justify drilling for that. There's no economics for it.

COMMISSIONER CASEY: Well, that's all. Thank you.

CHAIRMAN MUELLER: Mr. Cox, thank you very much.

THE WITNESS: Thank you.

MR. KEEFE: What's your pleasure?

CHAIRMAN MUELLER: Did you have any follow-up?

COMMISSIONER REAGAN: I just had one final thought here. It goes back to this lost and unaccounted for gas. Really the term is not lost. It's unaccounted for. And I truly believe if Public Service Company could get a couple of engineers to do a little paperwork tonight, or early in the morning, they could come tomorrow and show that the amount of gas consumed as fuel in 40 years of operation is most likely 80 or 90 percent -- I'm guessing now -- of this unaccounted for gas. And, therefore, I think we would be able to make the homeowners feel very comfortable in that there's no 3 billion cubic feet of gas floating around underground that will cause problems later on. It's just not properly accounted for in the operation of the reservoir.

MR. UDING: I have someone working on that now and hope to have something for you either tomorrow or Wednesday at the latest.

CHAIRMAN MUELLER: I thought you might.

COMMISSIONER SHOOK: I have one question.

CHAIRMAN MUELLER: Yes.

COMMISSIONER SHOOK: I have one additional question.

EXAMINATION

BY COMMISSIONER SHOOK:

Q I guess, in your expert opinion, will the fluctuation in water levels in the mine cause any future problems in seismic activity or subsidence?

A I would like to defer that question to Mr. Sherman. That's his area of expertise.

COMMISSIONER SHOOK: Okay.

THE WITNESS: Thank you.

CHAIRMAN MUELLER: Thanks.

MR. KEEFE: What's your pleasure, Mr. Chairman? As I say, I would either like to go full-blown with one witness, as long as it takes, which is not my first choice, or start with Mr. Sherman in the morning.

COMMISSIONER SHOOK: I move we adjourn.

CHAIRMAN MUELLER: We have one unsolicited comment. You have three more witnesses, correct?

MR. KEEFE: We do.

CHAIRMAN MUELLER: And, in total, what do you think that will take tomorrow?

MR. KEEFE: I think each of the last

three witnesses will take an hour.

CHAIRMAN MUELLER: Each.

MR. KEEFE: Including questions, yeah. I think we're looking at probably three hours. That may be an exaggeration.

CHAIRMAN MUELLER: So, starting at 8, and then -- so, you would finish somewhere around 11. And then the DNR witnesses, we probably finish up somewhere around noon, leaving six hours for 501 statements.

MR. KEEFE: That is correct. I would ask a question. You've used the term, "testimony," a couple of times now. We weren't actually aware there was going to be testimony by anybody else in that sense. We expected somebody would just give their appraisals. I wasn't sure what you meant by "testimony." Is there going to be questions and answers?

CHAIRMAN MUELLER: Are you talking about DNR?

MR. KEEFE: Yes.

CHAIRMAN MUELLER: I don't think it's really much more than questions and answers.

MS. BEAVER: I think it's just statements, essentially.

MR. KEEFE: That's what I thought.

CHAIRMAN MUELLER: I am sorry.

MR. KEEFE: That's what I thought.

CHAIRMAN MUELLER: It's inaccurate.

MR. KEEFE: And DNR is going to do one and who else?

CHAIRMAN MUELLER: Well, we'll have the Oil and Gas Commission, then DMG, and then the Department of Water Resources.

MR. KEEFE: Okay. Department of Water Resources is going to make a statement?

MS. BEAVER: (Nodding head in the affirmative.)

CHAIRMAN MUELLER: So, it could be -- the whole thing could be 15, 20 minutes. Okay. It's 20 of right now. There's really no point in getting started with another witness.

MR. KEEFE: I agree, Mr. Chairman.

CHAIRMAN MUELLER: I think we'll just be ready for a long day tomorrow, and get started right at 8.

MR. KEEFE: All right.

MS. BEAVER: Mr. Chairman, could you clarify if Public Service -- I think you've asked this, but it's getting late and my brain is a little jumbled. Did you ask for the three additional items to the closure plan to be provided in writing?

CHAIRMAN MUELLER: My expectation was that the closure plan would include -- modified closure plan would include those three additional items.

MR. KEEFE: Well, actually, I guess actually what we're going to do is just submit an additional three items, is what we're going to do.

CHAIRMAN MUELLER: That's fine.

MS. BEAVER: Tomorrow?

MR. KEEFE: Tomorrow.

CHAIRMAN MUELLER: Then, also, last we checked, before we came in, this last testimony, there have been no sign-ups for tomorrow yet. So. . .

MR. KEEFE: Are you going to place any sort of deadline on that, Mr. Chairman?

CHAIRMAN MUELLER: Earlier today, I said we would like to have it 15 minutes or so before we get started with it. So, that's all. All right. Well, thank you very much. Anything else?

MS. BEAVER: The room across the hall is locked. I am going to see if I can get it unlocked, so we can put our stuff in there.

CHAIRMAN MUELLER: Okay. Otherwise we'll see you tomorrow.

(Whereupon these proceedings were

concluded at 5:50 p.m. on August 18, 2003.)

CERTIFICATION

STATE OF COLORADO)
)
CITY AND COUNTY OF DENVER)

I, Harriet Weisenthal, do hereby certify that I was present and reported in stenotype the proceedings in the foregoing matter; that I thereafter reduced my stenotype notes to typewritten form, with the aid of a computer, composing the foregoing transcript; further, that the foregoing official transcript is a full and accurate record of the proceedings in this matter held at Golden, Colorado on August 18, 2003.

Harriet S. Weisenthal, RPR